PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

167-177 TIMES BUILDING, NEW YORK.

Established 1874. Incorporated 1889.

Telephone Call: Nassau 924. Cable Address: "Electrical," New York.

New England Office, 8 Cook Building, Boston.
Western Office, 39 Mallers Building, Chicago.
Philadelphia Office, 31 City Trust Building.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.

(Including Postage in the U. S., Canada or Mexico.)

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THE LONDON "ELECTRICIAN" IN AMERICA

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Arrangements have been made by which the London "Electrician" can be obtained from THE ELECTRICAL WORLD *office, 167-177 Times Building, New York.*

The rate of subscription (payable in advance), including postage, is $6 per annum to any address in the United States, Canada, Mexico or other foreign country.

Single copies, price 10 cents, can also be obtained at THE ELECTRICAL WORLD *office. Similarly* THE ELECTRICAL WORLD *can be obtained in England at the office of* The Electrician, *3 Salisbury Court, Fleet Street, London, E. C.*

The rate for "THE ELECTRICAL WORLD" to English or foreign subscribers (payable in advance) is £1. 1s.

VOL. XV. NEW YORK, MARCH 15, 1890. No. 11.

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Prodigality in Economy. IN his paper read before the National Electric Light Association, at Kansas City, Mr. C. C. Haskins points out the difference between true and supposed economy in electrical work, and cites numerous examples where a cent saved on material or supplies is not always a cent earned. He shows that, on the other hand, it is generally true that the best is the cheapest in the end, provided that it is handled by competent and reliable men and conscientious and thorough work is done throughout the whole plant. Mr. Haskins also holds that theory and practice go hand in hand, and one devoid of the other has no place in central station work.

Galvanic Batteries. IN our columns this week will be found an article from the pen of Mr. De Land, describing some of the early forms of galvanic batteries, and the modifications and improvements which have been carried out upon them by various inventors. The writer classifies them under three headings, the first of which, the Daniell or gravity type, is described in this issue. Such notes as these are especially interesting to those who have studied and worked upon the development of the galvanic battery, from which most of our early knowledge of the action and laws of electricity was gleaned. Although the dynamo electric machine has encroached somewhat upon its sphere, the galvanic cell still has a large field of usefulness distinctly its own.

Brake Measurements. THE simplification of power measuring apparatus, by means of which speedy and reliable readings may be obtained of the power delivered by a steam engine, an electric motor or other machine, is a question of great importance to the engineer, and one which has received considerable attention. Mr. W. F. D. Crane in this week's issue describes the application of a chart of mechanical horse power characteristics which he has devised to be used in connection with a suitable Prony brake, and which translates the results directly into horse power without resource to paper or mental calculation. He also clearly points out the precautions necessary for accurate working with the Prony brake, laying special stress upon the free and ample use of suitable lubricants. Anything which tends to facilitate work of this kind is a decided advance.

An Air Pressure Dynamometer. THE application of gases as a medium for registering power is employed in a highly ingenious manner by Mr. Guy Waite in the construction of a power metering apparatus and indicator described in the current issue. This instrument has been especially designed with the view of obtaining a meter which does not depend upon a reading of the power consumed for an instant only, or liable to frictional or other sources of error due to the employment of springs, as in the steam engine indicator. In the latest type of his meter Mr. Waite employs the compression of air due to the pull on the belt in connection with a special form of stationary gauge, and he claims that great ease in reading and accuracy in measurement are obtained. Such an instrument is capable of wide adaptability and is very convenient, as a continuous reading of the power transmitted may be taken, keeping a record and showing the work done consecutively.

Senate Electrical Investigation. THE examination by the Senate Committee of Mr. W. H. Brown, treasurer and manager of the United Electric Light and Power Company, throws considerable light upon the general laws regarding the distribution of electricity and methods for securing safety in operation. The interesting and remarkable fact was brought out that there are no regulations in the city of New York for controlling leakage of gas and no stringent rules concerning the supervision of gas and steam pipes. Mr. Gibbens, speaking as a citizen, suggested, and rightly so, that such restrictions and supervision over the laying and maintenance of such pipes as are exercised over the electric wires are exceedingly desirable. The gas companies, being first in the field, have heretofore had things their own way, but now in their vigorous hue and cry after the electric wires, instead of crippling that industry, they are liable to find their own methods examined into and regulated.

The Subways in New York. THE discussion of Mr. Maver's interesting paper on the practical working of the electrical subways, read before the American Institute of Electrical Engineers, and published in THE ELECTRICAL WORLD week before last, elicited some pertinent remarks on the question of underground construction. It was pointed out that the tunnel system, at one time considered by some, the only true solution of the question, presents disadvantages of distribution and cost which render it unsuited for any general system of distribution. Mr. Curtis championed the tunnel system, notwithstanding the enormous extra cost entailed thereby, remarking that service house connections could be made by simply boring through the wall of the tunnel into the cellar of the buildings to be lighted. For all that, we are of opinion that as regards water, gas and sewer pipes, it is preferable to allow them to remain as they are and construct separate subways for the reception of the electric wires. This is the view taken by those who are engaged in practically carrying out the work, and their experience ought to carry weight with it.

Central Station Growth. IT is worthy of comment the remarkably rapid manner in which the individual capacity of central stations throughout the country has increased, in many cases far beyond the highest expectations of the promoters. In this issue will be found an article descriptive of the fine new station of the Salem Electric Lighting Company, which illustrates this growth very aptly. From a single 10-light machine, as a starting point, after being thrice enlarged, this station has grown to have an ultimate capacity of 1,660 h. p. Compound condensing engines of large power, belted to the same shaft, are used. The relative merits of high and slow speed engines, either coupled direct or driving the dynamos by intermediate shafting, have been pretty thoroughly discussed during the last few years. It appears to us, and general practice seems to bear it out, that the question is principally one of the size of the station and available space, the important point being to so divide up the power as to allow of the engines being run as near as possible at their maximum output at all times, under the varying conditions of service.

Electrical Distribution in Mines. IN a paper read before the Federated Institution of Mining Engineers of Great Britain by Mr. Albion T. Snell, an abstract of which we publish on another page, the author describes in a clear and able manner the various general methods of electrical distribution that have been proposed and put into practice in mining work. He calls especial attention to the flexibility of the constant potential system of transmission where numerous motors of varying powers are required, and also strongly advocates the use of direct current converters, thus employing high-tension currents on the primary mains, and feeding the motors with the secondary current of lower pressure, and by this means economizing in copper in distribution over large areas. This method would certainly complicate the amount of moving machinery and, unless its certainty of action were assured would be open to objection on the score of unreliability of operation. By the use of a three or five-wire system, with the employment of suitable feeders, considerable areas are economically covered above ground, and such a system would be equally applicable for underground work and not open to the above objection. Mr. Snell refers with some doubt to distribution by alternate currents, but who can say, in view of the recent rapid strides in this system, that a reliable and efficient alternating current motor will not be forthcoming?

Lighting and Public Safety. In the March number of the *North American Review*, Mr. George Westinghouse, Jr., resumes the controversy on "Electric Lighting and Public Safety." The article is very interesting. It takes up the argument for the alternating current, and, indeed, will not allow that any other is safe for general distribution in cities, the assumption being that the integrity of the insulation barrier in the converter permits of an absolute separation of the street mains from the house wires, and that the use of the alternating system keeps down the load on each pair of street mains. Mr. Westinghouse also argues for underground work, and says: "The enormous pecuniary damages which, in obedience to public clamor, have been inflicted upon those electric lighting companies in New York having their conductors overhead, mainly because of ill-secured and abandoned telegraph and telephone wires which persisted in falling down upon them, have sufficiently emphasized the fact that it is not worth while for any electric company doing business in that city to give further consideration to the problem of distribution for light and power service other than by means of underground conductors." This is the actual situation; but, of course, it does not follow that there is necessity for underground wires in every town or city in the country; and, as Mr. Westinghouse points out, even in the large cities much yet remains to be learned and done toward the solution of the underground problem.

Conductivity of Colored Flames. SEVERAL attempts have been made to measure the conductivity of flames, and especially of those containing the vapor of metallic salts. These investigations have, up to the present, only furnished contradictory results. To obtain colored flames under definite conditions, Wiedemann & Ebert have, by means of a spray, impregnated the air feeding a Bunsen burner with a saline solution of suitable density, and have thus been in a position to know exactly how many milligrammes of metallic vapor were contained at any moment in a unit volume of flame. The character of an electric discharge is, of course, considerably modified by interposing a flame in its path; the discharges become more rapid, and the sound given out by a telephone is increased. On the introduction of metallic vapors into the flame, a still further change takes place, the nature of which essentially depends on the nature of the metal introduced. With potassium the telephone is reduced to silence, the discharge becoming almost continuous. Sodium, even in considerable quantities, produces a far smaller effect. In both instances the discharge remains disruptive in character, and there can, therefore, be no question of the flame being electrically conducting. Potassium and magnesium have peculiarly strong effects, due doubtless to the ultra-violet rays which they emit in abundance, and the effect of which, when they fall upon the negative electrode, is to lower the difference of potential necessary to cause a discharge.

NEW BOOKS.

Kalender fuer Elektrotechniker. By F. Uppenborn. Munich and Leipzig: 1890. R. Oldenbourg. 284 pp. Pocketbook.

This year's calendar has been enlarged and improved over that of 1889, and contains many and valuable data and facts arranged in convenient shape for the electrical engineer.

Magnetic and Other Physical Properties of Iron at a High Temperature. By John Hopkinson, M. A., D Sc., F. R. S. London: Trübner & Co., 1889. Price, $1.50.

These comprise the classical papers on this subject presented by Dr. John Hopkinson to the Royal Society, and constitute a most valuable record of work, the importance of which can hardly be estimated at the present time.

Coppering Tail Shafts of Steamers.

A correspondent of the "Steamship," with reference to the Elmore copper depositing process, makes a suggestion which possibly may prove of great practical utility in the shipbuilding trade. In alluding to the deposition of copper upon a mandril, this, he says, suggests to him a method of protecting the tail-end shafts of steamers from corrosion, and he inquires if this could be done, and at a cost low enough for its adoption in ordinary cargo steamers. It is well known that tail shafts often suffer from corrosion within the stern tube, due to the galvanic action set up between the gun metal liners and the iron by means of the salt water. This occurs more especially just at the ends of the liners, and, as the shaft cannot be inspected except by drawing out, the deterioration may go on for a long time unsuspected, and very serious consequences ensue. What is proposed, to obviate this, is to shrink the liners on in the ordinary way, and to cover the whole of the intermediate portion of shaft with a thin layer of copper by means of the above process.

The Thomson Welding Process in the Navy.

As noted in our columns recently, the Secretary of the Navy appointed a board to investigate and report upon the Thomson welding process, and in accordance therewith the board convened at Boston on Feb. 10, and devoted several days to the thorough study of the new process. The board consisted of Commander George A. Converse, A. S. Greene, Assistant Naval Constructor S. W. Armistead, and Ensign Gilbert Wilkes, U. S. A. Their report, which has just been filed, contains much of interest, and is made with special reference to the application of the process in the navy. We abstract the following from it:

"The process of welding in use by the Thomson Electric Welding Company has been fully investigated by the board, both experimentally by tests made in our presence, and by investigation of the theories and principles involved.

"We find that at the present time this process renders it possible, practically, to weld wrought-iron, cast-iron, brass and copper rods, from the size of the smallest electrical conductors in use for distributing purposes, to rods of 2½ in. diameter, and to weld pipes of larger sizes; to weld dissimilar metals, and pieces of different forms of cross-section; to join by welding the ends of wire cables, and to form welded rings of small or large diameter.

"We are convinced that the Thomson welding process can be found of great utility to the naval service, both on shore and afloat, for the following reasons:

"It can be used—

(*a*) In welding breaks in rods without altering them either in length or shape.

(*b*) For welding tubes.

(*c*) For welding angles and shapes of intricate form.

(*d*) For welding copper, brass, cast iron or other metals.

(*e*) For heating metals for forging, tempering and upsetting.

(*f*) For welding wire cables.

"Under these heads the following may be mentioned as a few of the many applications that would result on shipboard: For welding broken pump piston-rods, valve stems, etc.; for joining wires of iron, copper or other metals or bars of the same, of similar or different shapes or sections; for making joints at angles with bars (T or Y joints); for mending chain and wire rope; for constructing or joining, end to end, pipe of all kinds, and of large or small diameter; working or joining lead pipe; welding T-connections or elbows into lines of piping; welding safe ends to boiler tubes; repairing boiler tubes; welding eye-rings, and welding these again to bolts or bars; repairing cutting and boring tools without hurting their temper; lengthening or shortening rods or bars; repairing broken cast-iron pieces of machinery or broken cast-iron or cast-brass fittings; welding copper electric mains. This system of welding thus renders easy many operations in the working of metals which with the forge and smith have heretofore been considered impossible.

"It is the unanimous opinion of the board that in the present day of ships constructed almost entirely of metals, and in which every fitting possible is made of metal, such a system as that which has been investigated by us becomes not only desirable, but a means to economy of expense, time and labor, and would add to the efficiency of the vessel under any condition of service.

"This system of welding occupies a position of its own; it is able to do not only a large part of the work of the forge now in use, but is capable of doing much work that was hitherto considered unpracticable. By its use, the large accumulation of now almost worthless boiler tubes stored at the navy yards could be made fit for service, and the quantity of spare tubes and of many other stores now carried by ships could be reduced.

"As the classes of work at naval stations and on shipboard differ materially, the welders designed for use in the two places should be constructed for the work that will be required of them; those for use on board ship being especially designed with a view to lightness, compactness and adaptability to general work."

A Novel Storage Battery Plate.

Among the patents recently issued is one relating to a decidedly novel form of storage battery plate invented by Messrs. Justus B. Entz and William A. Phillips, of Schenectady, N. Y. The plate, or rather the electrode,

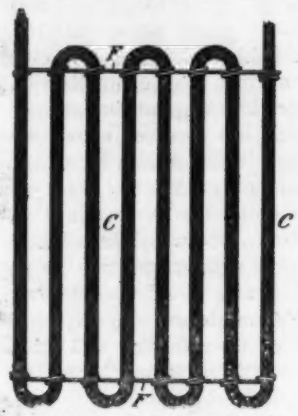


Fig. 1.—A Novel Storage Battery Plate.

consists of a flexible wire which has woven around it a net-work of finer wire, in the meshes of which the metallic oxide is embedded. The accompanying illustrations, Figs. 1 and 2, show the manner in which the electrode is built up. As will be seen, a solid wire core *A* of copper has a net-work *B* also of copper wound about it, the interstices being filled up with a paste *D* consisting of an oxide of copper. As an additional means for holding the oxide in place, as well as to prevent the plates from touching each other in the solution, a braid of cotton *E* is woven around the whole. The plate complete is shown in Fig. 1.

If this plate be used as the negative element of a zinc and copper primary battery in a solution of caustic potash, the hydrogen set free in the cell and tending to coat the plate will combine with the oxygen in the oxide, leaving a deposite of pure metallic copper in the meshes of the network. The plate is therefore nonpolarizable, and to reoxidize it, it is simply necessary to heat the plate, when it will oxidize in the air. When this same plate is used as the negative element in a storage-battery, the copper oxide serves as the active material to which goes the oxygen liberated during the charge. The wire net-work holds the

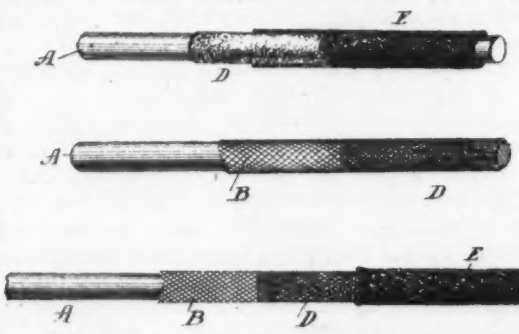


Fig. 2.—A Novel Storage Battery Plate.

material firmly in place, so that the plate, according to the inventors, will stand the heaviest discharge uninjured.

Action of the Current on the Human Body.

BY JOHN C. HENRY.

Just what takes place in the human organism to produce death from an electric current seems to be an unsolved problem. A few months ago I read an article appearing in one of the Kansas City papers; it was an argument against electrical executions, in which the writer feared that the soul of the victims would be destroyed. While this incident has no bearing on the subject of the article, it reminds us of the general superstition or ignorance of the subjects we at times have to contend against, and the necessity for common sense or easily understood explanations.

I have had a theory in regard to this subject so long that I have forgotten whether it is original or not. It is, that when a being suffers death from an electric shock, it is a pure case of internal rupture or explosion from the generation of gas or vapor. In support of this view I would refer to the many cases in which telegraph poles are torn to pieces. My observations on the plains, where it is a very frequent occurrence, is that the lightning follows the moist portion of the pole, which is the core or heart; in this case the moisture is vaporized and an explosion occurs. The high resistance produces heat, the heat, in turn, steam, and the steam an explosion.

In the case of a man struck by lightning it usually leaves blue skin marks, showing the course of the current in the body, and frequently tears the victim's boots. It will not be doubted that the marks are left by coagulated blood, which means ruptured veins, caused by expansion. We cannot conceive of any substance wedging its way through; it seems to be purely a case of heat and its effects produced by electricity. I think it is obvious that ruptured or exploded vital organs are sufficient to cause death, and it is a matter easily demonstrated that they are a natural consequence. To illustrate: If we take a long glass tube, pass a fine wire through it, fill it with water, seal up the ends, and lead the wire ends to the terminals of a dynamo, the result would be an explosion of the tube, the time depending upon the amount of current passing through the wire or its heating effect.

It has been suggested that death is caused by a magnetic or electrolytic effect; I know of no experiment that would demonstrate either of them, or heat, to be of any more force from an alternate than from a direct current; and yet our sages say the alternate current is the more dangerous. If this is true, we should grope around in the dark to find the other effect that may be useful in the service of man.

A Carbonic Oxide Indicator.

An apparatus for indicating the presence of carbonic oxide gas in the atmosphere has been perfected by M. Rasine. Its action depends on the property of spongy platinum to absorb carbonic oxide with evolution of sensible heat. Two metallic plates are placed vertically over each other, which when touching close an electric circuit. The upper plate is suspended from a hook by means of an easily combustible thread. This thread is wrapped in muslin, containing a little cotton powder dusted over with spongy platinum. If this arrangement is exposed in an atmosphere containing carbonic oxide, the spongy platinum will absorb it and set fire to the cotton, which will in turn burn the thread, and so cause the electrical contacts to complete the circuit, and ring a bell.

The Municipal Rapid Transit Problem in London.

Speaking recently in support of the Central London Railway scheme at the City Tradesmen's Club, Mr. William Morris (of Ashurst, Morris, Crisp & Co., solicitors for the bill) gave some interesting figures with regard to the increase in the number of passengers carried by the various companies within the metropolis. In the year 1864 the number of passengers carried by the London General Omnibus Company, the Metropolitan Railway, the District Railway and the tramways combined was 53,000,000; while last year the London General Omnibus Company carried about 80,000,000, the Metropolitan Railway and the District Company combined about 120,000,000, and the tramways 130,000,000; a total of 330,000,000, or an increase of over 600 per cent. During the same period the population of the metropolis had only increased 40 per cent. Those four companies carried every person in the population 90 times in the year, while in New York every person in the population was carried something like 200 times.

The Mehner Dry Cell.

An improved dry cell has recently been brought out by Dr. C. H. Mehner, of Berlin. In dry cells it is usual to employ as a vehicle for the exciting liquid a neutral material which absorbs the liquid excitant and forms therewith a stiff paste. The materials commonly employed for this purpose are sponge, sawdust, gypsum, gelatine, and the like. It is evident that the introduction of these inactive materials is prejudicial to the action of the cell, as they form an encumbrance which, apart from its purely mechanical action, in no way promotes, but on the contrary tends to diminish, the effective working of the battery. In order to dispense with this inactive matter, Dr. Mehner imparts the required consistency to the exciting agent by preparing it as follows:—The exciting salts, consisting of suitable chlorides of the alkalies, are mixed with a "mineral gelatine." This gelatine retains the salts in a paste, and, possessing exciting properties in itself, also acts as an exciting agent. The "mineral gelatine" consists of crystallized hydrated basic chloride of magnesium, which is formed by the addition of magnesia to a highly supersaturated and concentrated solution of magnesium chloride. If a suitable quantity of the solution of magnesium chloride is added to the oxide of magnesia, for example, in the first instance, a liquid product of a creamy consistency results, at first gradually gelatinizing and ultimately acquiring a pasty consistency. The degree of stiffness of the final product can be readily controlled by suitably regulating the addition of chloride solution. Dr. Mehner utilizes this property of oxy-chloride of magnesium in the preparation of his dry cell. He stirs the exciting salt with a solution of chloride of magnesium and calcined magnesia until he obtains a liquid of about the thickness of cream, which he pours into the cell. In the course of a few days the liquid changes to a stiff pulp, and the cell can then be closed. The "mineral gelatine" being in itself a substance capable of producing an exciting action in a galvanic cell, the employment of an inactive material is thus it is claimed entirely obviated.

The New Station of the Salem Electric Lighting Company.

For the supply of electric lights it is necessary to take advantage of every possible economy in order to place the business on a paying basis. In the construction of large stations with this purpose in view it is necessary that the designing engineer should plot out a curve which shall represent the total output of energy in twenty-four hours run. From this the motive power of the station can be selected and installed.

It will be found that at certain hours of the day the output will increase very fast, and later will decrease as rapidly. To install a large engine to accommodate the maximum power exerted would be an error in two directions; first, in case of an accident to the engine the entire machinery would be stopped, which would be detrimental to the business; second, as the plant is operating the larger part of the time with a light load, it will readily be seen that there is no economy in operating large engines in this way.

The economical electric light plants of to-day are constructed with a view of getting the best duty possible, and this point is arrived at by locating the station near a water front, where advantage of water freights can be taken, and also the use of water for condensing purposes. This calls for compound condensing engines, which have the advantages of economy in the higher pressures, and by expansion of steam to a lower temperature in the low-pressure cylinder. In connection with these engines, surface or jet condensers are used, which condense the steam into water and return it to the hot well at about 110 degrees.

By utilizing the escaping gases in the smoke flue, which are now ordinarily allowed to escape up chimney, this condensed water is returned to the boiler at about its boiling point.

In the selection of engines, many advocate the use of a number of units, making it possible to increase the engine power with increase of load, and decrease the engine power with decrease of load. This enables the user to run his engine with an overload rather than underload, the latter being uneconomical. In using several engines belted to the same shaft there are several advantages: if one should break down, its load can be divided among the others until it can be repaired, thereby giving the company practically a duplicate plant.

In the construction of stations, grave mistakes have been made in not getting them large enough, and thereby entailing two or three rebuildings; also from the fact that many are of the opinion that any place is good enough for an electric lighting machine. Electric lighting is a business the success of which depends upon the substantial way in which the apparatus is installed, and the application of energy and economy in its business management.

In giving this brief description of the necessities of an economical electric lighting plant, the construction of the Salem Lighting Company's new station is described.

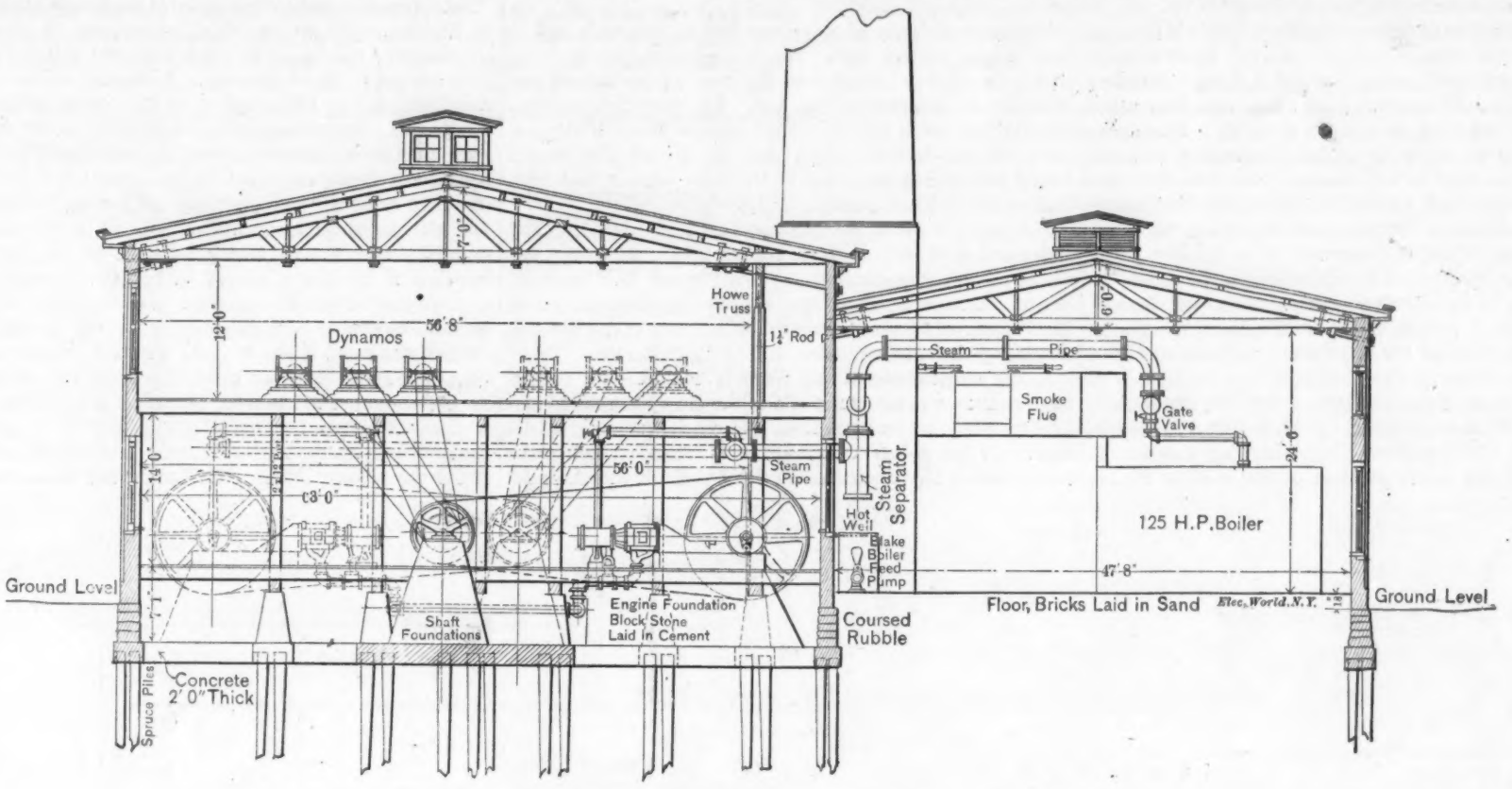


FIG. 1.—SECTIONAL ELEVATION OF THE SALEM STATION.

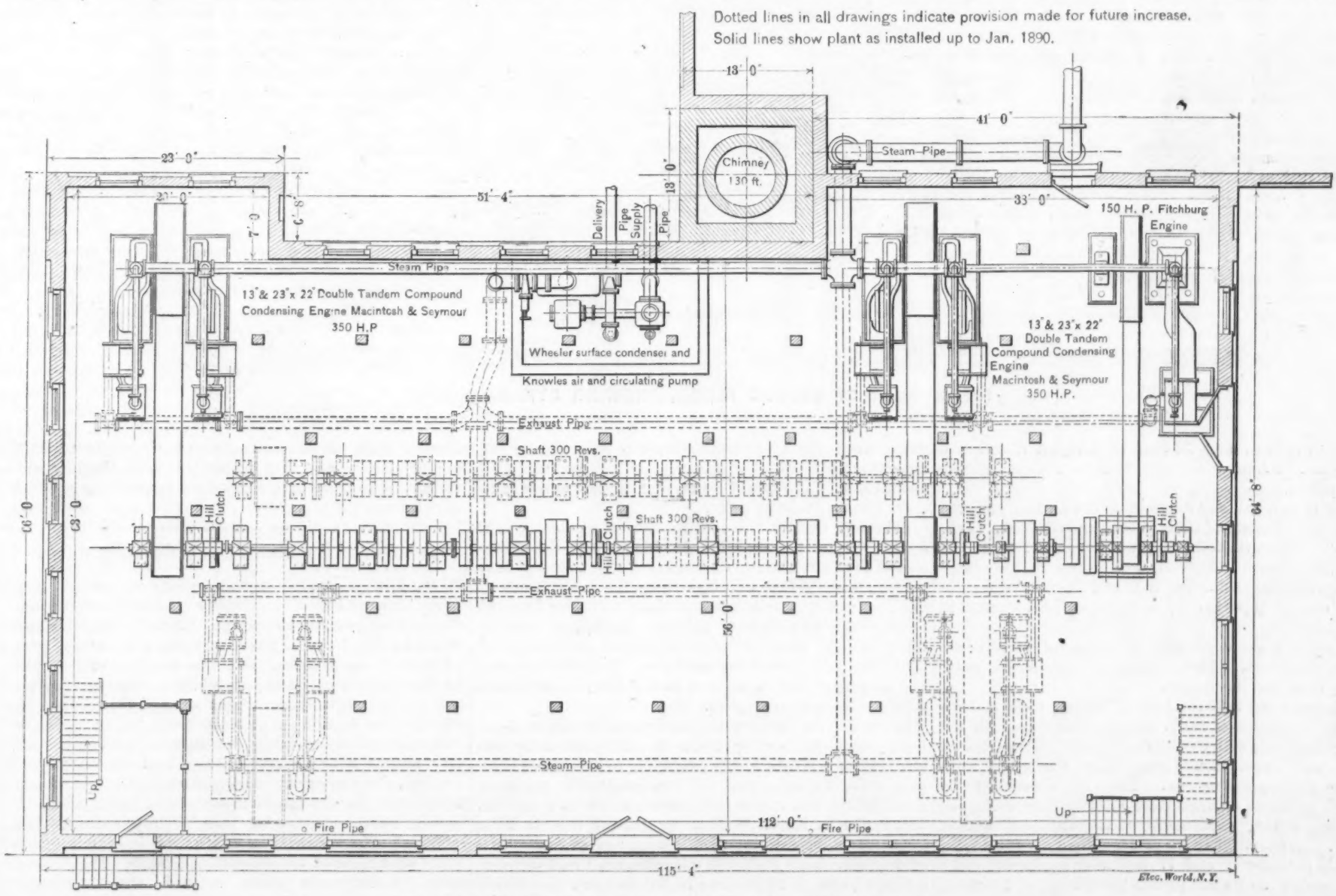


FIG. 2.—PLAN VIEW OF THE BOILER AND ENGINE ROOM.

The company was started in January, 1882, with a 10-light Weston arc machine, and after undergoing three enlargements, finally decided to construct a station which should not only be ample in its accommodations for a long time to come, but which at the same time should represent the best modern practice of combined mechanical and electrical engineering.

In the construction of the new station, which is situated on Peabody street, near the river, on the Burley wharf property, it was found necessary to drive about 1,000 piles, partly oak and partly spruce. This work was contracted for by Messrs. McIntire & Abbott, of Salem. These piles are held firmly together by an immense bed of concrete made of Portland cement and broken stone, which is two feet thick. On this bed, foundations for engines and shafting were constructed. These foundations are made exclusively of granite laid in cement.

In equipping this plant it was thought advisable to install one-half of its present capacity. This was done by the installation of two McIntosh & Seymour compound condensing engines of 350 h. p. each, and one engine of the Fitchburg Steam Engine Company's manufacture of 160 h. p. All three of these engines belt to the same shaft, which was made and equipped by the Hill Clutch Works, of Cleveland, Ohio, making it possible by the use of clutches to run any one of all three of the engines on the same shaft at one time. In case of accident a defective engine can be shut down, and the load at once taken up by the others.

Space is reserved and foundations are already prepared for two more engines of 350 h. p. each and additional shafting. This makes the total output of the plant 1,660 h. p.

The arrangement adopted is well shown in the accompanying illustrations, Figs. 1, 2 and 3, the portions in dotted outline representing the contemplated increase of plant.

The engines are condensed by means of the Wheeler surface condenser, which returns the condensed water directly back into the boilers.

The boiler house is 90 feet long by 50 feet wide and has space for ten boilers of 125 h. p. each, four of which are already installed, with the Jarvis furnace. These boilers are also placed upon granite foundations, which rest upon piles, as in the previous case. They are constructed in the most approved manner from specifications furnished by the engineering department of the Thomson-Houston Electric Company. They are of the ordinary tubular type, 72 inches in diameter and 17 feet long, made with extra strong seams and steel tubes, braced in a thorough manner, and have a working pressure of 125 pounds to the square inch. They were furnished by the Cunningham Iron Works, of Charlestown, Mass.

The piping of this plant has been done, taking into consideration the future output of 1,660 h. p., and all main steam pipes, as well as exhaust pipes, are large enough for this full duty. This has been done in the most thorough and workmanlike manner by Mr. A. A. Sanborn, of Boston, Mass.

The construction of the buildings was done by Messrs Lord Bros., of Somerville, Mass. The second floor of the main building, which is 115 × 66 feet, and shown in plan view in Fig. 3, is utilized for machines, and has a capacity for 45 Thomson-Houston dynamos, 15 of which were installed at once. The remaining space on the second floor not used for this purpose is divided into offices, work-rooms, testing-rooms, toilet-rooms, etc. This part of the work was done by Hamilton & Balcomb, of Salem, who are also the contractors for a coal shed of 2,000 tons capacity.

The brick chimney of this plant is 130 feet high and 13 feet square at the base. The chimney is square in form, with a round core 72 inches in diameter at the bottom and 78 inches in diameter at the top. The structure contains 215,000 hard brick laid in cement and also 41 perch of granite in the foundations, which rest on 60 oak piles, firmly bound together by three feet of Portland cement concrete. This chimney has a capacity of 1,500 h. p.

The entire work of the construction of the building and the placing of the engines, boilers and machinery was under the direct supervision of Mr. William H. Chapman, one of the supervisors of the engineering department of the Thomson-Houston Company, who was detailed for this service by the chief engineer, Mr. H. C. Patterson.

In the construction of this plant it has been Mr. Patterson's endeavor to construct one of the most economical and best running stations possible, and also of an original design. As the Salem Company had increased their plant twice before the constrnction of this plant, it was their desire to build one of such magnitude as to be entirely sufficient for the future; and as at present they are employing about 600 h. p., it would seem that there is ample in reserve for some time to come.

Believing that in the construction of an electric light station the best is none too good, and that the station should be so attractive to the employés that they will have a desire to spend their evenings there, the Salem Company has provided elegant accommodations, including bath and toilet rooms, with the later addition of a library, which is filled with the latest electrical books and periodicals, entirely at the disposal of the employés. This latter addition has not only proved of interest to the men, but of considerable value to the company.

Regarding the economy of steam plant, the change from high pressure to the compound condensing and to their present location has been highly gratifying to the Salem Company. Their average coal bills were reduced 50 per cent. after getting into successful operation in the new station. This is due to better facilities for getting coal in large quantities and also to the more economical engines. In a recent preliminary test made with Georgia Creek Cumberland coal, and steam pressure at 110 pounds, the boilers showed an evaporation of 9.7 pounds of water per pound of combustible. The engine, which was developing a varying load from 192 to 419 h. p. showed an economy of 1.8 pounds fuel per horse power per hour, and it is possible to reduce these figures somewhat at the regular test.

The commercial arc lamps now in use number 120; the city lamps, 180; the incandescent, 53 lamps of 65 c. p. (series), 44 of 32 c. p., and 2,000 of 20 c. p.

The arc dynamos number eleven of 30 lights each; the incandescent, two of 400 lights each; two 650 lighters, and one 1,300 lighter with 50 h. p. in motors.

To the energetic management by the officers, as well as the lively interest the directors have taken in the business of the company, belongs the entire credit of making the Salem Electric Lighting Company one of the most successful companies in the country.

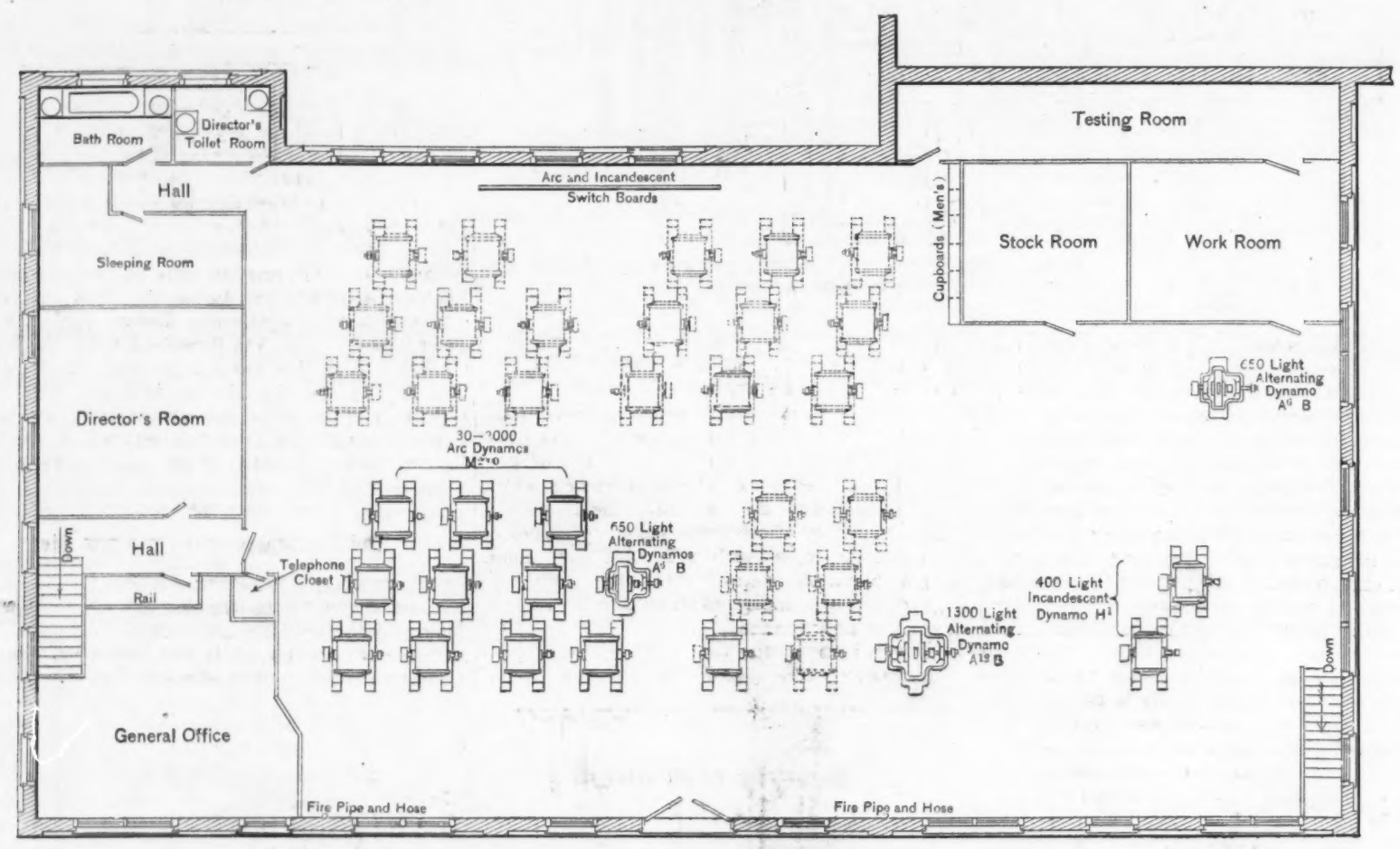


FIG. 3.—PLAN OF SECOND FLOOR, SHOWING DYNAMO ROOM.

Electrical Phenomena in Nature.

An interesting lecture was given at the London Institution on Monday, upon the electrical phenomena in nature, by Mr. Shelford Bidwell, who dealt with the subject mainly as it related to thunderstorms. Referring to the controversy initiated by Dr. Lodge as to the value of electrical conductors, the lecturer gave illustrations on the screen to show that such conductors were of considerable use during a period of steady electrical strain, while when an impulsive rush came it would probably fail to stop the discharge. The most a lightning conductor could do in the case of an impulsive rush was to bear the brunt of the discharge; but then it became a source of danger, because sparks might fly off it and do damage. In all cases of steady strain. however, a lightning conductor was good; in the majority of cases it was of great service; yet it could not always be relied upon as affording immunity from risk. As to the danger to life from lightning, it had been shown from the Registrar-General's returns that in 29 years in England and Wales the deaths from lightning had occurred at the rate of only one in a million of the population per annum. This was so small a percentage as to be scarcely worthy of note; and, said the lecturer amid laughter, one was almost as likely to be hanged for murder as to be killed by lightning.

The Right to Use Search Lights on Inland Waters.

To the Editors of The Electrical World:

Last summer I fitted the steamer St. Lawrence, an excursion boat running among the Thousand Islands, and owned by the Thousand Island Steamboat Company, with a 6,000 c. p. search light. This light was used every night for making landings at docks, picking up buoys and rocks, and as a help to the pilots when running difficult channels, and became almost an absolute necessity. A series of "search-light excursions" were inaugurated, which became very popular with the island visitors, and were well patronized. The beautiful cottages, islets and shores would be brightly illuminated by the powerful light, and presented a novel and extremely interesting appearance. The "search-light excursion" became one of the greatest of the many attractions of the Thousand Islands. The United States Government have notified the steamboat company that they must discontinue the use of the light. We would be much obliged if you could give us any points bearing on the subject. Is not the light used extensively on the Mississippi River and other inland waters, also on coast steamers and war ships? We want to make representation to the Secretary of the Treasury to allow us to carry this light the coming season.

J. M. Campbell.

Kingston, Can.

[Search lights are extensively used on the inland waters, as well as along the coast, of this country. We have ourselves witnessed, as water passengers, their advantageous use. We are not aware that their employment is against the law.—Eds. E. W.]

The Waite Power Meter and Indicator.

BY GUY WAITE, C. E.

While coal is sold by the ton, oil by the gallon, gas by the cubic foot, and even water and electricity are carefully metred, power, the result of the energy of these materials, is not often sold by measure or in any way which insures a value received between buyer and seller.

Much time and thought have been given, from time to time, to the invention of instruments for measuring power with very little success towards getting an instrument which practically fulfils the desired conditions. First of all, the instrument should depend upon perfectly accurate principles, in order to be reliable at all times. If possible, it should be independent of the elasticity of solids, such as springs, the elasticity of which is ever changing. It should be convenient to take it from one place to another, and be easily applied to the *machine* to be tested, without disarranging anything or hindering the ordinary work of the machine. No instrument which gives the power consumed, for an instant only, like the Prony brake, and the indicator card, can give satisfaction in determining the true characteristic of the power which a machine or a shaft is using.

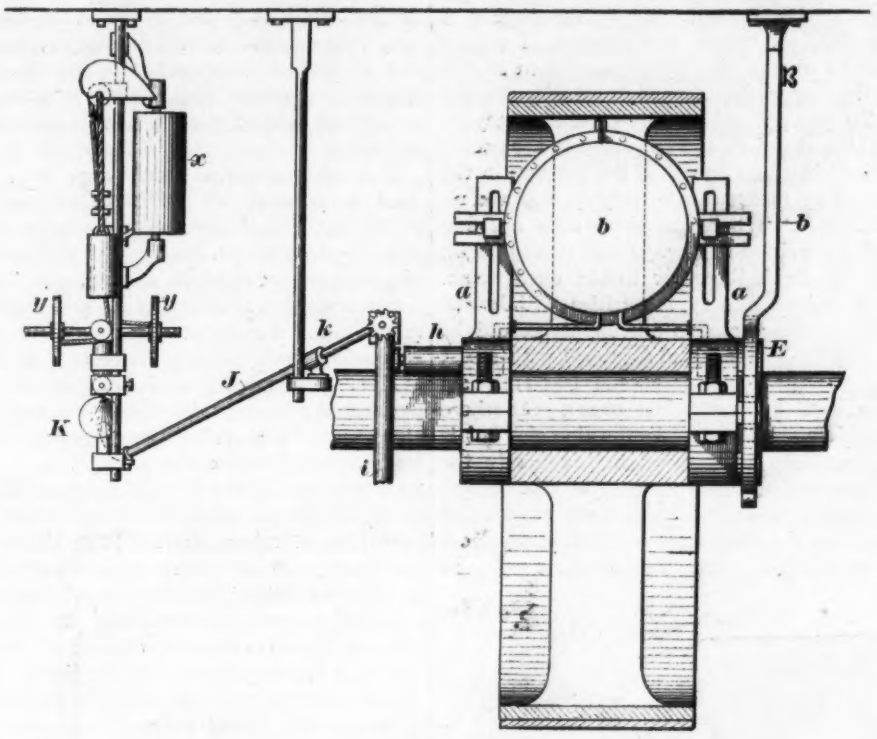


FIG. 1.- THE WAITE POWER METER AND INDICATOR.

The principal reasons that engine indicator cards do not give better satisfaction in testing for power is because they show the work of the steam on the piston for one stroke only, and whatever error there is in the diagram—due to imperfect acting of the spring, to the attachments for lateral motion, or to the calculation of the small area of the diagram—is multiplied by the piston area in square inches, which often reaches several hundred, and again by the strokes of the piston per minute.

The most serious error, however, is often due to the fact that the steam does not show in each stroke what work is being done in the machine being tested, friction of all parts, of course, being included.

During part of the strokes steam enough is furnished to not only operate the machinery, but to store up momentum in them; while during other strokes not enough steam is admitted to run the machinery—the accumulated energy of the balance wheel and machinery helping to perform this work. Such is the case in all engines where a sensitive cut-off regulates the speed.

Having had need for an instrument to test the power used by machines and shafting, I have been led into a careful study of the subject for that purpose, from all the points of the "compass," resulting in the deduction of an instrument believed to satisfy all necessary conditions to make it practical and accurate.

Very many different forms of the instrument have been designed. Some for metering only, some for indicating only, and some for showing the pull on the belt only, using a speed indicator for the revolutions. But all depend on the same fundamental principles, *i. e.*, a medium placed between the source of power and the consumer; while conveying the power this medium receives an impression which is registered.

After careful consideration of solids, liquids, and gases for this medium, the latter were chosen, for all ordinary rotating mechanism.

Air was chosen to receive the power from the shaft and convey it to the driving pulley of the machine, the power consumed by which is being measured.

In the latest perfected machine the compression of the air caused by the pull on the belt is in direct communication with a stationary gauge (of new type), whose indications can be read to any degree of nicety desirable. These indications on the gauge (to fractions of a pound when desired), are in electrical communication with a recording apparatus, when desired, which can be placed at any distance from the machine. Such contacts are governed by the rotation of the shaft and in so doing the product of the pull on the belt by the rotations or distance pulled is recorded in units, tens, hundreds, etc., in work on a system of discs. It is also interesting in some machinery, the dynamo for instance, to know how the product of the pull on the belt by the rotation of the shaft, *i. e.*, the horse power, varies, and what it is at different times when the number of lights varies during a night's run. For this purpose a continuous diagram of the horse power transmitted is taken, showing the record for all times during operation; at the same time the work being done is recorded.

Every moving part of the instrument is operated from the unlimited source—shaft or battery—so that the work of the machine is recorded absolutely independent of complication with frictional parts or with anything which prevents the exact pull on the belt being communicated directly from the pulley wheel to the gauge by means of the air pressure caused by such pull. The instrument, complete, may be carried in a case from place to place by one man, and the whole apparatus arranged on a shaft in parts, so as to be easily attached.

One of the first instruments made is illustrated in two views, Figs. 1 and 2. The medium which receives and transmits the power is the same in principle as in my other models, but the method of recording here is purely mechanical and necessitates some objectionable frictional parts, such as the air piston in *h*; here also a spring coil is used to weigh the air pressure, which is entirely obviated in the latest instrument.

The key to the pulley is taken out and an arm or arms (as the case may require) *a a* is fastened to the shaft next to the pulley. The air chamber *b* is fastened to the arm or arms, and allows the pulley-wheel to abut against a piston-like arrangement, which compresses confined air, the diaphragm *c* closing the front of the chamber. *E* is a small air pump, which keeps up a continuous supply of air by working its piston against a convenient loop which goes around the pump, having one end fastened to the floor or any other suitable place. This air pump causes an air pressure just sufficient to overcome the pull on the belt and keep the diaphragm *c* in its normal position, where it can sustain no tension whatever. If the diaphragm be forced out of normal, a safety valve at the top opens just sufficient to balance the air pressure and belt pull.

The air is led from chamber *b* to air cylinder *h*, having a piston which goes out and in, obedient to the different pressures. On the end of the piston rod is carried a wormed ring, *i*, which forms the junction between the rotating parts and the recording stationary parts. As this ring goes out and in it swings a pivoted rod, *J*, one end of which slides on the ring, the other end slides a cone, *K*, backwards or forwards under a disc wheel, *u*. This disc wheel rotates by friction on the cone, and the amount of its rotation will depend upon the rotation of the cone, multiplied by the distance that the disc is from the apex of the cone; but the distance from the apex is proportional to the pull on the belt, and the rotation of the cone is proportional to the distance the belt travels; hence the disc wheel will rotate proportionally to the work, and with suitable discs connected with the rotation of the wheel *u*, the work will be recorded.

For taking a continuous diagram of the horse power, a "speedometer" governed by centrifugal force is used. In this instrument the speed is proportionate to the horse power, and it is governed in such a way that the movements of weights *y* shall always be uniformly proportional to the speed. The cylinder *x* governs the paper on which the diagram of the horse power is taken, and may make its revolution in any desired number of hours.

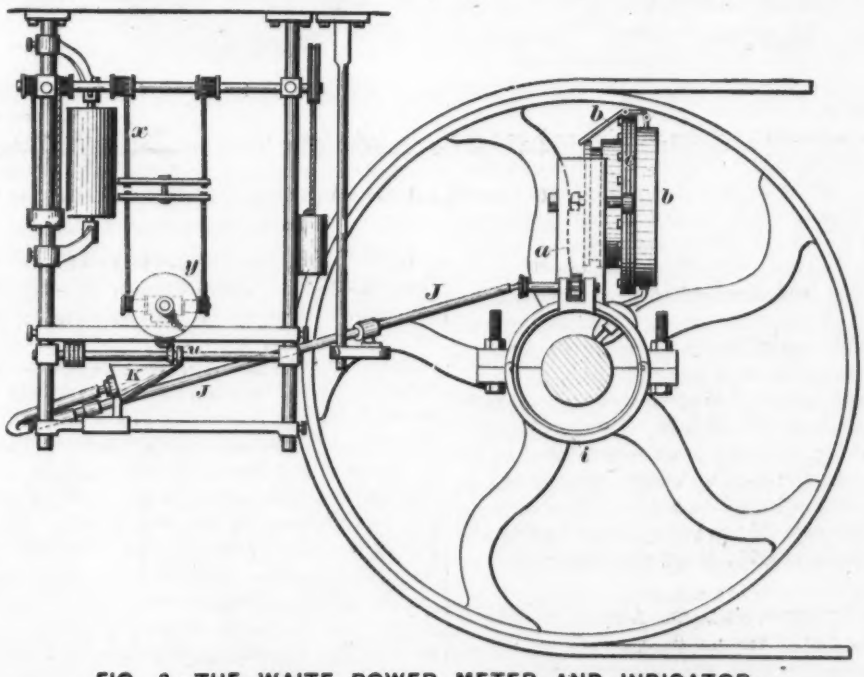


FIG. 2.—THE WAITE POWER METER AND INDICATOR.

Electrical Prize in Belgium.

The Brussels *Moniteur* publishes the report of the jury appointed to judge the papers sent in for the mixed competition of 1888, opened by the King of the Belgians, and having as its object: "The best work on electricity as a motor and as a means of lighting, on the applications which are or may be made of it, and on the economic advantages likely to result from the employment of electricity." The international jury, presided over by M. Montefiore Levy, Senator, has placed first among the works submitted for competition, "The Elementary Treatise on Electricity and Magnetism," by MM. Van Rysselberghe, E. Lagrange and G. Royers; but, while recognizing that this work answers more exactly than any other to the object of the competition, the jury regrets to state unanimously that it cannot award the prize. The secretary reporter to the jury was M. Eric Gérard, director of the Liége Electro-Technical Institute.

The Usefulness of the Electric Light.

To the Editors of The Electrical World:

I wish to give you an item that may help to offset the danger of the deadly electric current.

Wednesday evening, about 8:30, two ladies were passing a street corner, when their attention was called to a stream of smoke issuing from the ventilator on a frame barn owned by D. H. Young and situated about 200 feet from the corner. The smoke was plainly seen as the light from a 2,000 c. p. arc lamp fell directly on it. The alarm was immediately sounded and fire was discovered in a pile of grain sacks that were thrown loose in a manger. The flames were then almost high enough to ignite the hay in the mow. The barn was a very tightly built barn, well battened, and only the light falling on the smoke could have called attention to it in time to save the valuable contents. The fire was undoubtedly the work of an incendiary.

I hope people will begin to see that it is a gross mistake to condemn an element that promises to be the best friend and servant that man ever had—a servant that can be controlled by the pressure of an infant's finger.

BRYAN, O. W. E. KAUKE.

An Improved Form of Electro-Mechanical Gong.

We illustrate this week a new and improved form of electro-mechanical gong, now being extensively used for police alarm work, manufactured by Messrs. John P. Cushing & Co., of Boston. This gong, it is stated, is for an equal amount of work much more compact and lighter of structure than those of other manufacture, owing to certain mechanical improvements. It will also give a very rapid stroke, being specially designed for that purpose, and requires only four cells of Gassner battery to work it. The mechanism is operated by a strong spring contained in a case underneath the toothed wheel shown at top of cut. By a train of wheels, when the current relieves the catch by means of the attraction of the armature, the right-hand end of the horizontal lever is made to rotate swiftly. The end of this lever is attached to the lever which operates the hammer, and each revolution of the lever causes a stroke on the bell. Unlike other gongs, however, the hammer strikes the bell by force of its own momentum only, thereby preventing any racking of the framework, and a little spring, shown bent on the cut, brings back the hammer to rest without any jar to the mechanism. The cut shows the hammer in the action of striking, and it will be seen that when the spring referred to straightens, the bar attached to the end of the hammer rod comes back into a vertical position, and catches on to a pin on the horizontal lever. The horizontal lever controlling the hammer is held at rest by pins on the under side of the upright lever next the electro-magnet, and is freed from the same at each attraction of the armature, allowing it to make one revolution, and thereby producing one blow on the gong.

The whole gong is fitted on a suitable wooden base, with a hinged lid over the working parts, and looks extremely neat and compact. So successful have these gongs been in police stations that they are now being rapidly taken up by the electrical trade, and the fact that they are made by Messrs. Cushing is sufficient guarantee that they are substantial, accurate and perfect in every detail, as they are rapidly attaining a name in New England for good, solid mechanical work in combination with the most delicate electrical devices.

Some Elementary Notes Regarding Galvanic Batteries.

BY FRED DE LAND.

Connect two dissimilar metals or chemicals placed in any one of certain fluids, and chemical energy will be converted into electrical energy, the material used and its container being generally referred to as a galvanic cell, while the "coupling" of two or more such cells form what is known as a galvanic battery.

A rod of zinc and a stick of carbon immersed in a solution of common salt, or of sal ammoniac, form one of the simplest known cells and yield a given amount of electricity as soon as the ends of the two electrodes, zinc and carbon, are connected together by a piece of copper wire or bit of metal; the current passing from the zinc in the first cell through the fluid to the carbon, and thence through the connecting metal to the zinc, liquid and carbon in the second cell, and so on, continuously through the entire circuit if more than one cell is connected.

The plates which compose a battery, as zinc and carbon or zinc and copper, are called "elements;" though that term should apply properly to only that portion immersed in the fluid, the term pole being applied to the remaining part. The positive pole is the one through which the current leaves the cell.

Of the innumerable batteries devised from time to time, a great number have possessed special features; others, quite numerous, have been of sufficient value to warrant their retention in service, or their being placed on the market. But the general public know of so few individually that, in explaining their construction and showing the work each is best adapted for, they can be classified most easily under three types, namely: the Daniell or gravity form, so called because the separation of the fluids is due entirely to the difference in the specific gravity of the liquids; the Leclanché and its many modifications; and the Bunsen or bichromate cell.

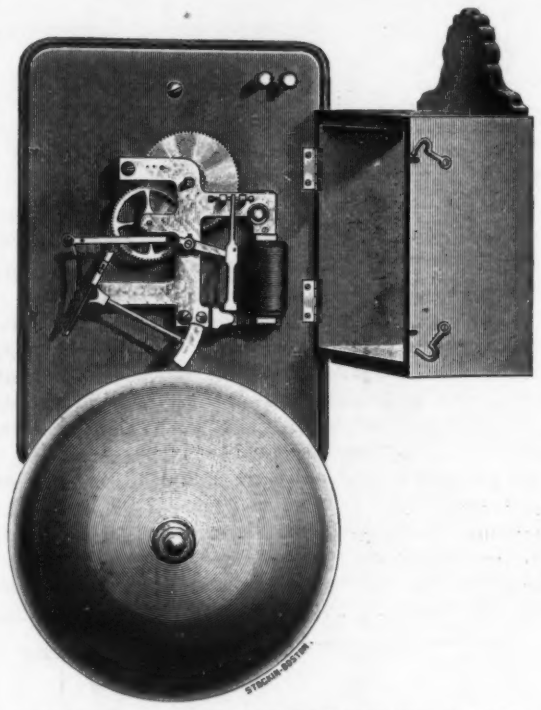
THE FIRST TYPE—THE DANIELL CELL.

In 1837, John Frederick Daniell devised the first constant battery, using two fluids. The modified Daniell of to-day is a decided improvement over the original, and answers the purpose admirably where a light but continued flow of current is desired, not easily polarizing and consuming but a small percentage of zinc. It labors, however, under the disadvantage of having a clay, porous cup that in time becomes covered with a deposit of copper, requiring renewal, and a comparatively expensive copper element, defects that have been remedied in the crow-foot form of gravity cell.

The modified Daniell cell consists of a glass jar 8 inches high by 6 inches in diameter; a copper cylinder formed from a sheet of No. 30 B. & S. gauge soft rolled copper, 11 inches long by 6½ inches wide, with a pocket 3 inches by 3 inches by 1½ inches attached, having a hinged cover, a perforated bottom, and holding half a pound of blue vitriol; a white clay, porous cup, 8 inches by 3 inches, placed within the cylinder, and a two-pound four-wing or star-shaped cast zinc placed within the porous cup.

When the battery is required for use, fill the glass jar and the porous cup with water to within three inches of the top of the latter; fill the pocket in the copper cylinder with blue vitriol (sulphate of copper) and close the circuit by connecting the ends of the wires together for a few hours, when the battery will be ready for use.

Continuous action converts the zinc in the porous cell into zinc oxide, which the acid dissolves, forming sulphate of zinc and saturating the water which is partially decomposed, liberating the hydrogen, which passes through the porous cup to the strong solution of copper, that practically absorbs it, and leaving no portion to assume a free condition and coat the negative element. Thus all possibility of polarization is prevented, unless the solution of copper grows too weak to absorb the hydrogen, when it will gradually cover the copper element and eventually prevent useful action. To prevent this result, a fresh supply of small crystals of blue vitriol should be placed in the pocket every ten days, and about one-fourth of the solution in the porous cup removed by means of a battery syringe and replaced with fresh water. Where numerous cells are employed, it is a wise provision to always use two syringes, one to withdraw the fluid, the other to add clear water, thus preventing the return of any impurities withdrawn. About once in ten weeks the zinc and copper should be taken out, thoroughly scraped and scrubbed with a stiff brush before being replaced; they should last fully six months, and have been known to last over a year where the battery was seldom employed. As the zinc element is consumed the copper plate is increased in practically the same ratio; for there is about one-fourth its weight of pure copper in each pound of blue vitriol, and the decomposition of that amount means the consumption of full four ounces of zinc and the deposition of nearly that amount of pure copper on the negative element. The resistance of a Daniell cell of the size described is four ohms, and the electromotive force is 1.079 volt.



Improved Form of Electro-Mechanical Gong.

CROW FOOT GRAVITY BATTERY.

John Fuller in 1853, Cromwell F. Varley in 1854, and Callaud in 1861 experimented with various modifications of the Daniell with a view of securing the same constancy while doing away with the porous cup and changing the shape of the copper to a less expensive form. Finally, Callaud devised the simplest form of cell, employing the principle of specific gravity in the separation of the fluids, and thus rendered unnecessary the expensive form of copper element and the porous cup employed in the Daniell. This cell has been employed to a large extent in France, and was also used in this country until 1880, when a cell having the same elements, but of a less expensive form, was placed on the market and called the "crow foot" gravity battery from the resemblance borne by the zinc to a crow's foot. Since then this cell has been generally adopted by all telegraph companies, and has displaced thousands of the small but powerful nitric acid cells, devised in 1839 by Sir William Grove.

The principle of the separation of the fluids in the crow foot cell is the same as in the Daniell, and is explained as follows: The solution of copper sulphate, having a higher specific gravity, falls to the bottom, while the solution of zinc sulphate remains in the upper portion of the jar and surrounds the zinc element. The ordinary cell consists of a glass jar 6 inches wide by 8 inches high; a form of copper cross is made by riveting three sheets of hard rolled sheet battery copper of No. 32 B. & S. gauge, 6 inches long by 2 inches wide, to a No. 16 B. & S. gauge copper wire covered with gutta-percha insulation, and a three-pound zinc is cast in a form resembling a crow's foot.

In setting up the cell, the copper strips are bent in the form of a Greek cross, and placed on the bottom, with the end of the wire overlapping the edge of the jar. The zinc is suspended on the opposite edge of the jar by the hook on the shank. Sufficient water is poured in to just cover the zinc, and about a pound of blue vitriol is dropped in, or a quantity sufficient to cover the copper cross, if steady, continuous work is desired. The wires are then connected and the battery allowed to stand for from 24 to 48 hours, when it will be ready for work. Or the action can be secured more quickly by adding a teaspoonful of sulphate of zinc to the water. But in the latter case it is best to add the blue vitriol to half a jar of water, then to dissolve the teaspoonful of sulphate of zinc in sufficient water, and gently pour the same into the jar to within two inches of the top. When the two solutions have properly separated, the lower of a deep blue color and the upper nearly colorless, then suspend the zinc in the jar, connect the wires, and it will soon be ready for service. This avoids the deposition of copper that is always found on the zinc, and retards the action, when left in during the separation of the fluids.

No further attention should then be required until the need of a fresh supply of blue vitriol is shown by the receding of the blue color below the top of the copper cross; or the replacing with fresh water of a portion of the upper fluid (solution of sulphate of zinc), when its specific gravity is indicated by a hydrometer to be 35 degrees or over. A reading of 15 degrees or under indicates that the battery is growing weak through the absence of sufficient sulphate of zinc. The transfer of the liquids should be carefully performed with the aid of a large battery syringe. It should also be noted that as the blue color falls below the cross the internal resistance increases.

Cells of the gravity type are especially useful where a light current is desired for continuous work, as in the operation of telegraph lines, fire alarm signals, electric time service, small motors, etc., as great economy is shown in the amount of material consumed and in the care required for their maintenance. They are not suitable for ringing house bells or for work of a similar character, owing to the number of cells required. Occasionally cells of the gravity type are coupled to secondary or storage cells and the stored energy afterwards used for various purposes, but except in special cases the economy of such action is questioned. The solution freezes at about 20 degrees Fahrenheit, so that care must be taken with the cell in cold weather, more especially as the internal resistance rapidly increases in all cells as the temperature of the fluid approaches the freezing point.

The E. M. F. is rated at 1.10 volt, and the internal resistance at 4 ohms, and, like the Daniell, the E. M. F. is nearly constant and not changeable as in many other cells. But it will not prove economical to obtain any but the lighter powers from gravity cells as the current strength, being only about one half ampère and the normal E. M. F. about one volt per cell, the output of electric energy is about one-half a watt, or one-fifteen-hundredth of a horse power. In other words, it would require 1,500 cells in circuit one hour to furnish one horse power hour of electrical energy.

THE HUSSEY CELL.

A form of cell belonging to the gravity type and somewhat resembling the Daniell, but containing new and distinctive features, has been in practical operation in New York during the past year to the entire satisfaction of the users. The cell consists of an outer glass jar; a copper disc; a clay cup standing on four short legs and made porous only through the raised bottom surface, the sides being glazed to prevent any absorption above the lower edge; and a four wing plate of an amalgam of mercury and zinc that stands within the cup.

In charging this cell the space between the sides of the glass jar and that of the porous cup is partly filled with blue vitriol, and the latter is then covered with a weak mixture of sulphuric acid in water. This acidulated solution is also poured into the porous cup to a much higher level than in the glass jar, thus securing the advantage of a downward pressure that is always constant, and where ordinary care is shown, preventing the solution of copper from ever reaching the zinc and forming thereon a deposition of copper—a fault prominent in the Daniell and crow foot forms. As the blue vitriol is consumed, it constantly feeds downward toward the bottom of the jar and porous cup, thus furnishing fresh solution of sulphate of copper to the active portion of the cell.

Among the advantages claimed for this cell are its constant E. M. F. of 1.10 volts; its low internal resistance of less than a quarter of an ohm; its economical consumption of zinc, and the slight attendance required to keep it in perfect operation, it being only necessary to replenish the blue vitriol and to occasionally withdraw the exhausted solution in the porous cup, and to replace it with fresh solution by means of a battery syringe.

Large size cells of this type have proven of economical value in charging storage cells, and are now being constantly employed for that purpose, as well as for all the ordinary applications of closed circuit work; and while the E. M. F. is only about the same as in the crow foot cell the internal resistance is said to be sixteen times less, thus increasing the quantity of current generated to full five ampères.

THE DELANEY CELL.

This cell was described before the American Institute of Electrical Engineers by its inventor, Mr. P. B. Delaney, as follows:

The sulphate of copper is inclosed in a strawboard box,

and the zinc in a paper envelope, and the rim of the jar has attached to it on the inside by a sticky substance a band of rubber cloth. The advantages claimed for the cell are as follows: When the battery is first set up the dust of sulphate of copper is not instantly dissolved and diffused throughout the liquid, coating the zinc with copper, as is the case with the ordinary cell. Several minutes elapse before discoloration of the fluid begins, and then only at the bottom of the cell, from whence it rises very gradually, never reaching the zinc. If the box be filled, the charge of copper is always uniform. Deposited or spongy metallic copper cannot fall upon the crystals from the zinc, and caking or massing in the bottom of the jar is thus prevented. The copper electrode is held firmly in position, always the same distance from the zinc.

In a battery of any considerable number of ordinary cells it would be difficult to find two alike in this respect. There is little or no stalactite formations from the zinc, and consequently no local action, rendering the battery very useful for open circuit work. When water is poured in to make up for evaporation, the equilibrium of the fluids is not disturbed. The deposit on the zinc thus protected is easily removable, requiring no hacking or scraping. One zinc will endure two charges of sulphate of copper.

The band around the rim is one of the most important features of the cell, as it prevents zinc sulphate from creeping over. It offers simply a mechanical obstruction. It works perfectly in practice.

THE GETHINS CELL.

In order to avoid the frequent and heavy local action due to the mixing of the two layers of liquids employed in the Daniell type of cell, Mr. J. L. Gethins, of Boston, has followed somewhat closely in the steps of Daniell, but instead of using a sack made from the membrane of an animal, a porous cup of peculiar shape is employed to separate the liquids, the design being such that the gravity principle is retained and assisted by the interposition of a *horizontal* partition between the layers. The liquids thus have a sharp line of division, and their intermingling is effectually prevented.

The porous jar is provided with a rim which acts as a support, the whole resting on the upper edge of the glass jar. The zinc electrode rests on the bottom of the partition.

The use of the cell over extended periods has demonstrated that no filling of the pores of the partition with copper takes place, and that in several instances a year's constant work was effected with a single charge of 4 pounds of copper sulphate and the consumption of 1½ pounds of zinc. The E. M. F. of the cell is 1.07, and its internal resistance about 3 ohms.

Prony Brake Horse Power Characteristics.—1.

BY W. F. D. CRANE, M. E.

The Prony brake has long been a standard power-measuring instrument among engineers, and is frequently used by them as the most trustworthy and stable in adjustment when the conditions are such as to admit of its adoption; and it is noteworthy that its design, as still used in certain connections, has been little subject to modification over the simple form in which it was originally devised, and that its working principle, being fundamental, has been subject to no alteration whatever. Such modifications as have taken place from time to time have been specifically those of design and the mechanical details of construction necessary to adapt it to the exigencies of the connection in which it was to be used. To the complete accuracy, simplicity, cheapness and convenience of this brake as an absorption dynamometer most suitably adapted to motor tests must be added, in addition to the simplicity of its operation and of the apparatus itself, the facility and rapidity with which the results of power measurements may be obtained.

As the rule for calculation, we have the simple formula,

$$H.\,P.=\frac{2\,\pi\,P\,d\,n}{33{,}000},$$

which may be further simplified to $H.\,P. = K \times P \times n$; K being the equivalent of the fraction $\frac{2\pi d}{33{,}000}$, where d is the length of the dynamometer arm. P and n are variables, and represent, respectively, the pounds in weight in the pan, and the number of revolutions. With a convenient value of K suitably predetermined from a length of area compatible with the other dimensions of the apparatus, the product of these three factors can be most readily obtained, and not infrequently, with convenient numbers, the results may be quickly determined by a brief mental calculation alone. When the figures are such that a mental calculation becomes irksome, resort must be had to paper, slide-rule or a similar labor-saving device.

To eliminate calculation as much as feasible with the degree of accuracy required, the writer has devised charts of mechanical horse-power characteristics, which will be described later, and which serve to illustrate a principle widely applicable. They have been used with considerable success by the writer, under certain circumstances, with saving in time and labor, and by others who were even ignorant of the principle involved in their construction or that of the apparatus and tests from which the data were derived.

The general design of a brake and pulley which are found to give excellent satisfaction in practice, is given in the side elevation and centre section shown in the accompanying engravings. The general dimensions are as follows: diameter of pulley, 16 inches; face, 4 inches; thickness of rim and web, three-quarter inch; hub, 3 inches deep by 6 inches in diameter, and bore from 1¼ to 2 inches, according to diameter of shaft it is intended to fit. The hub is made of ample diameter for all ordinary usage, but may be still increased with advantage to guard against accidents which will sometimes occur, such as the bursting and sudden stopping of an armature, when the inertia of the revolving pulley throws a sudden and excessive strain upon the three-quarter inch set screws, the points of which must either tear the shaft or crack the hub, both of which are apt to occur and disable the pulley. Fortunately, such an accident seldom happens. The dynamometer arm is of one-half inch by two inch wrought iron, securely riveted to the inner iron clamp bar, and has three-quarter-inch holes for the insertion of S-hook fastenings.

It will be seen that the pulley is provided with outside and inside flanges, the latter of which form channels or gutters between the flanges and the web. These channels are provided for the reception of water or oil which, by evaporation, absorbs and moderates the heating effect inevitable when the brake is run under load for a length of time. For similar reasons the wooden friction blocks should be kept well saturated with some very heavy grease. The thicker the body of the grease the greater is its heat absorbing qualities, with less resultant wear and tear in the friction blocks, which otherwise follows as the result of poor lubrication. Ordinary tallow, oils and water are entirely inadequate, especially so when the power being

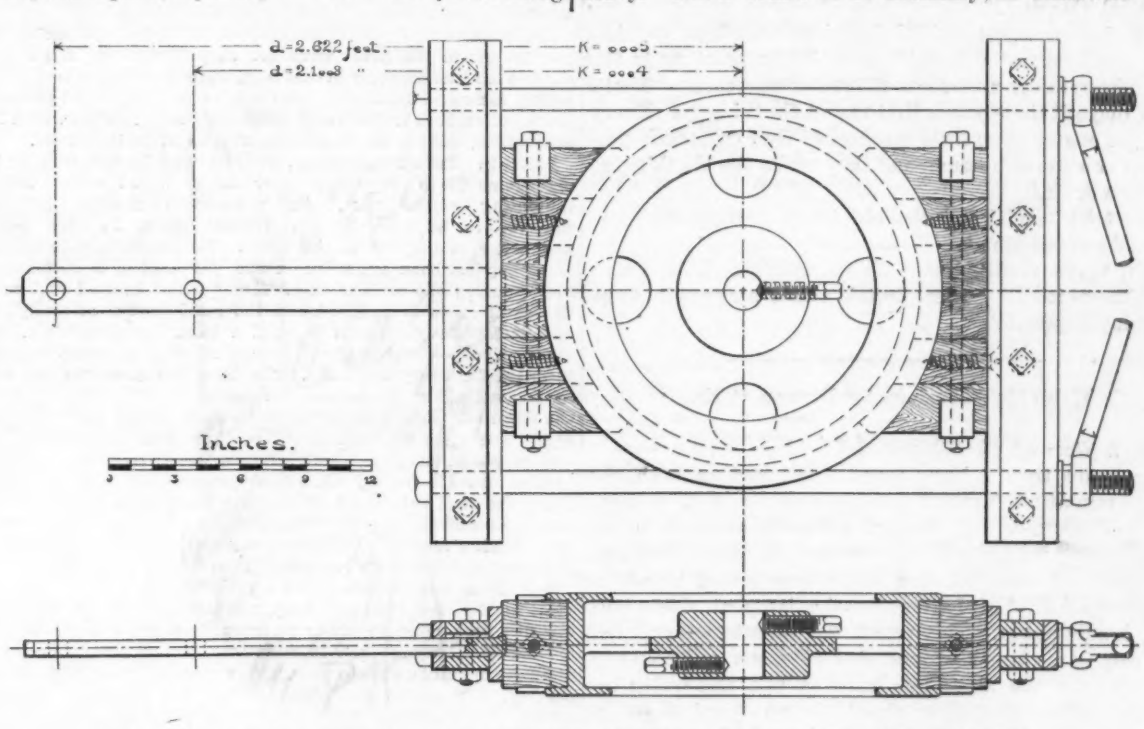


FIG. 1.—SIDE ELEVATION AND CENTRE SECTION OF BRAKE AND PULLEY.

absorbed is of any magnitude, that is, in this size of brake, from 6 to 15 or 20 h. p. In the larger articulated forms of friction bands, for spanning large circumferences, such as engine drivers, it is more or less customary to allow a stream of water to play continually upon the wheel and brake band to keep the apparatus cool; but the use of water alone in this connection is to be deprecated, inasmuch as, if the friction blocks have not been previously most thoroughly saturated with oil or grease, they are apt to swell, warp, crack and shrink as a result of the alternate wetting and drying, adding much to the natural wear and tear of those parts, with perhaps alteration in the exact value of K.

In the form of brake illustrated, it is imperative for exactitude in maintaining K truly constant, that there shall be an inappreciable wear in the lower friction block; hence the necessity for thorough lubrication with a heavy grease, which shall absorb the heat generated, and waste itself and not the wood of the block.

The friction blocks or shoes, are made up in sections of hard seasoned oak, with the wearing surface across the grain.

Two values of K are given for the brake apparatus illustrated. Both are simple expressions, .0004 and .0005, each containing a convenient digit as a multiplier, and they require that d shall be 2.1008 and 2.622 feet respectively. In taking the readings either constant may be used with equal accuracy, the choice being subject to convenience or conditions; and if the constants be used alternately, we have a ready means for checking the results, as given by one against the other, by simply changing our fastening to the arm from one hole to the other. The charts are constructed with the use of the constant .0004, requiring the length of arm to be 2.1008 feet; and the dynamometer to which these charts are applicable must have that length of arm. $K = .0004$ is also applied to the following examples:

Since, as our formula shows, the horse power developed by the brake is dependent upon a constant and two variables for a given power, if P be small, n must be such as to equate the value of H. P., and conversely, if P be large, n will be proportionately small. From the extreme limits of the horse power it is desired to measure, predetermining K by trial and error, we may learn the extremes of weights and speeds to be provided for in designing the parts subject to strain.

If nicely balanced, a pulley of the size shown may be safely run at a speed of 1,500 revolutions and over; and the friction of the upper block alone, due to the weight of the clamping apparatus and dynamometer arm, will balance a weight of from 2½ to 5 or 8 pounds with the arm 2.1 feet in length, the lower block being loose. Assuming 1,500 revolutions (n) and 2½ pounds (P), we have 1.5 approximately, the lowest horse power we can hope to measure with this size of brake, and that but approximately, as our value of k is now no longer .0004; for the loosening of the bolts to allow the lower friction block to hang free, has increased the value of d.

Again, assume that we are obtaining 15 h. p. with the same brake apparatus, and that the speed is but 100 revolutions. This requires that the weight shall be 375 pounds, and the bolts and clamp bars should be made sufficiently strong to develop enough friction to balance that weight; and the dynamometer arm, likewise, to guard against binding, with ample margin for contingencies. Such data obtain in train car work when measuring the power at the car axle, and indicate the power required in starting, in overcoming curves and on grades.

It is to provide for the great pressure which must necessarily be brought to bear upon the friction blocks in measuring the larger horse powers at slow speeds, that the construction of the clamping apparatus is made apparently so heavy. This is found to be necessary, as otherwise the pressure of the tightening screws bearing upon the ends of the crossbars is apt to bend the latter without producing the desired tightening effect. The clamps are therefore made of ⅝-inch wrought iron, after the manner shown with one inch tightening rods, to prevent stripping of the thread. Where measurements of equally large or intermediate horse powers are to be made, but at higher speeds, the construction shown may be serviceably lightened by the use of a single one-inch flat or light channel bar to cap off the wooden friction blocks.

The present brake, as designed, is intended to be used in a strictly vertical position. This does away with the necessity for balancing any of the parts, which would otherwise be imperative if the lever or dynamometer arm were used in a horizontal or other position, and eliminates errors which otherwise enter into the readings of the value of W, due to an original false balance or by a derangement of the apparatus caused by the vibrations set up by the revolutions of the pulley.

Unless due care be observed in mounting the pulley on a shaft properly fitting its bore, the vibration which will ensue and be especially noticeable at one or more particular speed or speeds, may be sufficient to utterly vitiate all readings of the weight, and thus destroy the accuracy of the results. Where the pulley is provided with removable bushings to admit of its use with motors whose shafts differ in diameter, it is especially needful that they be good tight fits, as the excessive vibration which they are pretty sure to introduce, if loose, may make the apparatus worse than useless and even dangerous.

The writer has never had satisfaction when using a spring balance scale to determine the weights in connection with the practical brake described; the vibration or oscillation of the arm, the connecting link or cord to the scale, and of the scale itself making readings impracticable and impossible for other than a guess at their accuracy. Instead of this a light, inextensible cord or wire rope is attached to the arm and passed through a frictionless pulley block and securely fastened to a suitable weight pan or "pot,"

the exact weight of which is known and included in the readings. With this arrangement the weights are easily and rapidly handled with considerable assurance that the reading of the weight is at least exact. In taking the speed or revolutions of the armature, we do not always have the same assurance. If an ordinary hand-speed counter be used we have no knowledge of the variations in this speed which may have taken place during the one-half, full minute or more, required for the reading, though they may have been plainly visible in the voltmeter. A reliable tachometer (if such exists) is much more suitable, convenient and time-saving, and permits of more real simultaniety in the readings of all the instruments employed. The saving in time alone is indeed appreciable, and if reckoned in wages and the increased efficiency of those engaged in the tests would soon pay for the cost of the instrument.

Rural Ideas of the "Electric Limited."

It was at the Union Depot, Chicago, on the morning of the arrival of the "Electric Limited" from the east. The engine had been detached and the fine train stood by itself on the platform.

"An' look a'here, Marthy," said an old fellow who appeared as if he had come from the deepest of all deep woods. "Marthy" was evidently his wife, and as she murmured, "All right, Jabez, I'm comin'," her face wore a wondering expression of rural simplicity.

"Now, this is the 'lectric train," said the old tiller of the soil. "Ye see there be no ingine to it an' it runs by 'lectricity."

"But I don't see no 'lectricity," interposed the more practical "Marthy."

"Wall, then squat, an' I'll show it to ye. D'ye see that little macheen under there?" asked Jabez, pointing to the air brake cylinder under one of the Pullman cars. "That's whar they git their power that makes the thing go. Every car's got one of those little macheens—they call them promoters or some sich name, and they make the old thing go like Sam Scott."

"Du tell!" exclaimed the old lady, straightening up. "That does beat me!"

"Oh, that's nothin'," said Jabez, with the air of a man who knows it all. "These 'lectric trains air growin' to be ev'ry day happenin's."

Chloride Solutions in Bunsen Cells.

To the Editors of The Electrical World:

For some time I have been experimenting with the Edison miniature lamps. I began with a 1 c. p. lamp and three common 1 qt. Bunsen batteries, charged in the common way with the zincs immersed in dilute sulphuric acid and a saturated solution of bichromate of potash in the porous cell. This battery ran the lamp at about half up to candle power. This result was unsatisfactory. On referring to my books I found that a Bunsen cell could be charged with the zincs immersed in salt and water instead of acid, so that there should be no chemical action when the circuit was open. Having charged the batteries in this way, using common salt with the zincs and immersing the carbons in a saturated solution of bichromate of potash, to which about a sixth part of strong sulphuric acid was added, I connected the three cells with the lamp and they ran it considerably over candle power.

Now, why should a cell charged with salt give a higher E. M. F. than one charged with acid? Could you inform me if there is any battery more suitable for running miniature lamps than the Bunsen charged in this way? My room is now lit by a battery of seven cells, which runs two circuits of lamps placed in multiple arc. One circuit consists of three 3 c. p. lamps, and the other of two 6 c. p. lamps. The current thus obtained is not sufficient to run both of these circuits at once. Sewall Cabot.

Brookline, Mass.

[Answer.—A slight increase in electromotive force has frequently been noted as the result of immersing the zinc in a chloride solution, while the carbon is surrounded with a sulphate. For an instance, a certain type of Daniell cell, having 0.909 volt, may be raised to 1.060 volts by the substitution of a solution of common salt for the sulphuric acid around the zinc. This effect appears to be due to the fact that salt water is itself to a small degree electro-positive to dilute sulphuric acid. And in general, it might be safe to state that the chlorides are all slightly positive to the sulphates. It is probable, however, that the increase would disappear as soon as the acid from within the cup had diffused itself somewhat through the fluid about the zinc. But any supposable variation of electromotive force due to the use of salt alone could not account for the advantage which our correspondent reports in connection with the second set of cells. It will be observed that in the first instance he uses only "a saturated solution of bichromate of potash in the porous cell," while in the second instance he uses "a saturated solution of bichromate of potash, to which about a sixth part of *strong sulphuric acid* was added." The addition of the sulphuric acid to the bichromate solution in the porous cup accounts for the results obtained.—Eds. E. W.]

Prodigality in Economy.*

By C. C. Haskins.

The cautious man of business, when the dull season comes round, goes carefully over his past record, scans his methods, weighs his successes and failures, and endeavors to arrange his future so as to increase the former, and to the greatest possible extent diminish the latter. If he finds that by a liberal expenditure of energy or money in some particular direction he has made satisfactory advance, he seriously considers whether more extended effort in that direction will not still further aid in the general result for which he is striving; and he as carefully passes by and ignores those plans and efforts which have proved either disastrous or very moderately successful.

There are times and occasions when such retrospective examinations of methods and systems are demanded by circumstances, and—as in religion and politics—a revival seems to be required to bring the record of the past up to the programme of the future, that the one may be used for the improvement of the other by direct comparison. In such a connection, I have thought that possible good might result from canvassing the question, whether there has not been in the past, whether there is not now, among the electrical fraternity, an inclination to practise a sort of delusive economy in many directions, a policy which, to use an old and homely proverb, is "penny wise and pound foolish."

A few years ago, when the arc light was hardly more than a possibility, the fraternity, composed wholly of those whose electrical education had been acquired while handling nothing heavier than a quadruplex telegraph battery, brought such knowledge as then existed to the work. One line that I call to mind was put up with dry cotton-covered wire—magnet wire—and the terminals of the line were carried to ground through the gas and water pipes. It was a commendable job, for the best was done with the knowledge at hand. Truth to tell, it would not have been a very dangerous affair if it had got away entirely, for it was a very small plant, and like many another nursling, quite feeble. It was not long until the owner demanded an improved circuit, and again the best wire in the market was used. A second time the plant was overhauled, and the second wire was not considered good enough, but was substituted by one of the best rubber wires known to the trade. I should add that in each instance the plant on being overhauled, was increased in size as well as improved in construction.

I once asked the owner of the property, if the alterations and improvements in the plant were not very expensive. His answer showed me true economy in coal bills, wear and tear of engine and boiler, increased immunity from danger to person and property, and a better, both brighter and steadier light at less cost, with less rebate bills, and less unpleasant interviews with his patrons.

I have in mind a second plant, where it was deemed wise by the management to purchase everything which could aid in tabulating expenditures, in the more readily handling the work to be done in the dynamo room, in the engine and boiler rooms, and in the office. No inconsiderable amount of money has been expended in the purchasing of instruments for procuring the various data. Every pound of coal and every bushel of ashes is weighed, and the results are as carefully kept and as faithfully exact as those of a bank bookkeeper's balance sheet. The performances of the engines and dynamos are duly recorded for every day's run. The lines are measured, not only for insulation, but for copper resistance as well, and a record to the minutest particular is made up daily for the eye of the manager. The most minute leak is thus discovered in time to prevent a great waste, and is repaired before sunset if possible, so that no greater strain is set up when the dynamo is again set in motion. Since the first revolution of that engine there have been paid in repairs—renewals of parts damaged by electricity—less, during over twelve months' constant running, than on many a plant of one-quarter the capacity is wasted in the item of oil alone.

A plant not unlike the one last mentioned, one in which all these vital matters are recorded daily, and tabulated for the manager's eye, has been cited to me as an example of what may be accomplished by a study of such information. In this plant there are 14 dynamos in daily use, consuming an average of 1,900 pounds of coal per day. The record shows that of this there is about 15 per cent. waste. The manager shows that he is using four and one-half pounds of coal per horse-power an hour. And for the engines, shafting, dynamos, etc., one barrel of oil is consumed per month. I would gladly mention names in these cases were it not that my lips have been sealed by parties furnishing the information.

Oils for lubrication are as plenty as blackberries, and 12 cents, 15 cents, 20 cents per gallon has a fascination for him who searches for bargains in oil. An apt illustration of the economy of cheap oil was lately given in a railway publication. According to the writer, on an Ohio road, the newly appointed superintendent of motive power learned that the valve oil in use, costing 32 cents per gallon, was giving an average run of 100 miles per quart. He found, also, that an average of one valve seat per day was being faced at the shop. He ordered an oil used that cost 50 cents per gallon, which gives an average of 200 miles run per quart, with only five valve seats to face in four months. Fifteen valve seats to face in a year, as compared with 365, and half as much oil to do the work of the cheaper lubricant. In other words, 25 cents against 32.

Another case comes more directly in our line. Oils costing 12 to 15 cents were found to answer well enough in an engine and dynamo room, so far as heating was concerned, but no pains were taken to look beyond that effect, until, after a time, it was discovered that the journals had a silvery white instead of the polished, mirror-like appearance they should present. Calipering the shaft showed that with the cheap oil the shaft had worn away more in three months than it should have done with a proper lubricant in as many years.

The time wasted in chaffing and canvassing for a bargain in cheaper oils might be more economically used by the purchasing agent in athletic development, to the end that oil fiends and other greasy tramps might better comprehend the words "no admittance," which should ornament the door of every dynamo room. Present company is, of course, always excepted.

As it is true that no man knows more than the rest of the world, so it is true that no one man can do all that is to be done in the various departments of a central plant. But human nature is weak, and the range of human eyesight is limited. It is not by any means seldom that the principal official of the plant endeavors to transact his business from the table of his roll-top desk, without ever getting his legs from under it to see personally how matters are progressing. Jones calls and arranges to have half a dozen lights put in his store. The manager orders the superintendent to have it done. The superintendent passes the order to the foreman of construction—from thence it goes to the foreman of a gang, and he gives the order to a couple of his "Indians" to do the work. From the manager down to the foreman of the gang, inclusive, no one knows anything more about that installation than the King of the Sandwich Islands. If it goes all right, nothing is ever heard of it, but if a fire occurs, or some person is injured, the whole fraternity, the electrical light and power service of the entire world, has received a black eye which requires months to heal. What is everybody's business in this case should be the business of an inspector.

Different methods of managing plants are illustrated by a couple of centrals not very far from Kansas City. They represent extremes. In one of these there is a general impression that someone had done it himself. The dynamo is in a building which seems rather to have grown under adverse circumstances than to have been constructed intentionally. It stands on posts, the space between these boarded up from the ground to the sills. It has all the advantages to be derived from ventilation, and it is well up from the ground. In one portion of the room stand the engine and boiler, threatening destruction to the establishment by either shaking it down or blowing it up, if one may judge by the second-hand appearance of everything. The line is in excellent keeping with the rest. My informant says the wire lies on roofs and against buildings, and is a constant menace to person and property. Connectors in place of soldered twist joints are so constant as to give the idea of the company's having secured a great bargain by purchasing all some concern had, and the consequence is that the lights are unsteady, weak and blear-eyed, while the dynamo has assumed a sad, unhappy cast of countenance, such as one sometimes meets the day after Christmas. The reason for all this unhappy condition of affairs is found in a false economy; the employment of incompetent engine and dynamo men and other cheap ignorance. The result may be foreseen—the plant for sale.

But a short distance away from this disgrace to the fraternity and the art, there is a sucessful plant run as it were by a one man power. There are over 100 arc lights, and one of two persons sees individually every one of these each day. The parties are father and son. The dynamos are as thoroughly cleaned as possible every twenty-four hours, and there are no corners for the accumulation of dirt that are not carefully looked to. There is no greasy sawdust under foot, no oiled rags stowed away for spontaneous kindling material. Everything is kept snug, clean and in order throughout the entire plant, and the total amount of repair expenses for one year was merely nominal. This plant is not on the market.

These are no fancy sketches. They are taken from life. I fear the first named case has no representative here—it would be well, perhaps, if it had.

A case of false economy I copy from The Electrical World, of Dec. 14 last. In this instance an electrical engineer, compelled by a railway accident to remain over night in a small town, visited the lighting station to kill time, and found a mere lad in charge, who told him the plant had not turned out as profitable as was expected, and the stockholders were growling about the prospects. Inspection of the circuits showed that while they were in excellent order, with the exception of a loosened connection or two, the lights were not giving out their normal brilliancy. Returning to the station, he located the trouble in the boiler room, where he found the grate bars covered with a mass of hardened clinkers, through which but little air could circulate, and which required the most severe exertion to remove, while further examination showed that neither the flues not the tubes had been properly cleaned for months. All this was remedied the following day, with the result of plenty of steam, good light, and a saving of about one-third the fuel. The writer goes on to say that even this pointed and striking lesson in economy was lost on the directors. The boy was retained and permitted to go right on running the plant in his own feeble way.

In construction there are many points of present saving at the risk, if not the certainty, of future loss. It costs much less to use the ordinary porcelain door knob for out-of-doors insulation. Yet even with the best insulated cable there is positively no real economy in such construction. Neither should a wooden cleat be made to do service for retaining a cable in position. The former, holding as it does by a single screw, is incapable of sustaining the wire or cable securely, and the repeated replacing and renewing consequent upon the use of these knobs, if the line is kept in proper condition, soon far out-balances the price of glass insulators firmly fixed on iron or wood brackets.

Nor should wires crawling along the face of buildings be fastened to the cornices or water tables. Carried out from the wall by an iron bracket, and attached to glass, two great advantages are gained. There is no contact with the wall, and the window washer cannot stand upon the wires to break the insulation and thus increase the danger of accident, and the possibility of the conductor being reached by occupants of offices or flats is greatly diminished.

The objection to an iron staple over a heavy wire or cable is that sooner or later the weight of the conductor will sag, weakening the insulation, if not cutting it through completely. The wooden cleat is scarcely better. Experience has shown that upon a line where such cleats are used, the retention of moisture by the wood is almost certain to weaken that point, so that when a ground is developed elsewhere, adding to the strain already existing, the cleat aids materially in the development of the second ground, with its consequent unpleasantness.

It costs a little more at the time, but in all such positions the farther we get from the wall or the wood, with air for both ventilation and insulation, the greater the economy in the long run.

No inconsiderable expense is sometimes incurred in covering arc light conductors within a building with a neat and ornamental molding. It is pretty, but expensive, when, as in an instance where I was a witness after the fact, an unnoticed leak from an imperfect skylight developed a second ground on a heavy circuit, and the insurance fell short of the damage done. In another instance, where wooden cleats were used to confine a cable in a side walk area, grounds were developed in half a dozen places almost simultaneously from a very similar cause, and an expensive piece of conductor was ruined. In the first of these two instances, painting or even bronzing the wire with varnish bronze would have been sufficiently ornamental, and the porcelain knobs could have been treated similarly. In any event, but a few days after a line wire is run through a room it has ceased to be a nine-days' wonder, and is seldom ever thought of again. So of lines outside. When first placed every one sees them, and all sorts of criticism and comment are the order of the day. In a few days the gossipers have some other target for their witticisms or remarks, and the wires are permitted to rest.

There is one exception to this rule. In the experience of almost every central plant management, there is one individual who says that under no circumstances can any electric light wire pass his premises. He seems to have been born a coward, and nothing on the surface of the footstool can make him brave unless it is one free lamp. The economy here is compulsory and not to be questioned.

Is not the unfortunate condition of affairs at the East, with all its concomitant newspaper and magazine literature, its bickerings, injunctions and other legal entanglements, traceable either directly or indirectly to a mistaken economy? Is it not fair to presume that at the outset, with a reasonable expenditure in first-class material, much of the business unhappiness and the mental bitterness which the electrical fraternity and the outer world, metaphorically speaking, have been forced to swallow, would have been spared them?

* A paper presented before the National Electric Light Association, Kansas City, February, 1890.

A difference of forty, perhaps fifty dollars per mile of conductor, I believe, would have worked wonders as a peace and harmony panacea, and left fewer raw spots and blisters on the electrical animal, to be gradually nursed back to health and vigor. I may be wrong, but I strongly incline to the belief that where false or dangerous systems of economy have clashed with legal authority, the savings so accumulated are more than balanced by rebates, legal expenses, loss of patrons through stoppages or poor service, or both, in the long run.

Every new industry is compelled to fight for an existence. If, like the electrical enterprise, it must elbow its way into notice, taking the place of a competitor in the front rank, it must make enemies, and of necessity antagonize those whom it discomforts and crowds to the background. It is not an attribute of the descendants of Adam to submit tamely to rebuffs and usurpation, and no opportunity is ever lost of disfiguring the countenance of the newcomer. To give occasion for and encourage these opportunities by our own acts seems to me to be short-sighted and illogical.

It is true that electric lighting and power have made wonderful and monstrous strides in popularity, considering the youth of their existence, and they will continue, despite every opposition, to grow in grace and strength, till they have relegated to the rear ranks every other form of illumination, and crowded the present clumsy, hot, ungainly engines from their vantage ground, as the circus elephant clears the tanbark ring for the riders. But the public has some voice in the matter, and the higher the standard of excellence to which the electric light and power man brings his work, the more rapidly will the circle of usefulness widen and the more tranquil will his enemies have become.

The parties in whose interest legislation on the installation and use of electricity for illumination was first invoked, were unwittingly chargeable for the many setbacks and the want of progress which checked the enterprise in its early days, and are not wholly free from blame, though indirectly, for the present troubles. These were the fire insurance people. These men deal only with combustion. There is to them a magic in the word incombustible. Say fire-proof to an underwriter and his heart leaps with joy. It was a sharp trader who exhibited a cotton covered, painted wire to the insurance people and demonstrated that it did not readily burn. "Just the thing," said the actuary, and the president, and the inspector, and they all smiled at the honor conferred when the cunning merchant baptized it for its godfathers, and called it "The Underwriters' Wire." There is a class of hard citizens who usually have an alias. The underwriters' wire is to-day best known by its nickname.

Another misfortune has been handed down to us from the early days of electrical illumination, which I look upon as one of the original sins of the business. The magneto bell. I have written and scolded and begged to have this abomination sent out of the realm, but, like Banquo's ghost, it will not down. I find it everywhere, and if I ask the party in charge of a plant what his insulation is, I am quite often told that it is "first-class; my bell won't ring, no matter how fast I turn it." A short time ago I took occasion to measure the resistance through which I could ring the bell of one of these guaranted for 15,000 ohms. With a really smart grinder, we did manage to get a slight response through 6,500 ohms, and when I included the manager with the first-class line he claimed to have, and turned the magneto crank, the effect was marvelous. He made several florid remarks on the occasion, and bought a bridge set the next day. He has since told me repeatedly that the investment has paid him several times over in line economy.

A magneto has no method of giving information beyond the fact that there is or is not a bad condition of affairs on the line. If there are two or more faults, there is no possible way of distinguishing when the linemen have found one of these, except in a negative sort of manner So soon as the insulation is raised to a point where the bell refuses to ring, its maximum of usefulness is reached. Take the case of the line just mentioned. A maximum insulation of less than 6,000 ohms resistance would be the best that instrument would show. The waste of current, the unsatisfactory lights, both as to brilliancy and steadiness, the useless labor of the generator, the coal waste, the danger to life and property, all those faults which follow in the wake of such weak insulation, certainly confer no honor on an economy which persists in using an instrument that can virtually do no more than show up a dead ground.

Nor is it any better as a method of testing the insulation of fields and armatures. It is far more potent for mischief than is generally suspected, for the spark generated is of very high tension, and is quite likely to cut across and open the way for a short circuit when next the machine is used, by weakening the insulation. And, again, the magneto being the sole dependance of the station, the services of an expert are far more often required than they otherwise would be, while the vexatious delay, the annoyance, and, afterward, the bill, which seems outrageous, cannot be placed to the credit of the economy account. Yet the magneto seems almost as persistent and hereditary as John Calvin believed original sin to be.

The dynamo man and the engineer, when these are two, are often refused, on the score of expense, the most reasonable demands. A case which struck me quite forcibly I may mention to illustrate my meaning. The attendant at a plant found that a portion of the paper driving pulley was becoming loosened, and that in order to restore it to its normal condition he needed a peculiar form of wrench. The manager was notified, but refused to allow the purchase, although the sum required was but a few cents. He said the company could not afford it, and the engineer must get along the best he could. He did the best he could, and so did the pulley. It went to pieces. The dynamo belt went into the engine governor gearing, and the entire plant had a three days' vacation. The lost time, rebates and repair bills would have paid for several bushels of such wrenches as were needed to repair the pulley. There are other and many simple, but necessary, appurtenances of use and convenience, too often refused on the score of economy, which repay the original investment many times over during their existence.

Coupling up high potential dynamos in series to save wire is doubtful economy, to say the least. Insulation is subject to damage from within as well as from without, and two lines of thirty lamps each will last longer and pay better than one with sixty lamps run by two thirty-light dynamos in series.

When renewing, the belting of a plant is sometimes a matter of considerable anxiety; occasionally the desire to get a few more days' service out of an old one involves possibilities which may be extremely hazardous. The chances, in case of a break, of the belt becoming playful and familiar, always suggest to me that belts are like oil paintings—made to look at, not to smell of. Yet many a belt has been thrown away as useless because of its having become accidentally greased to that extent that it refused to hug the pulleys. This may be remedied by covering the driving pulley with a leather band, the width of its face, fastened on with counter-sunk bolts. In a comparatively short time the belt, provided it is not again greased, will, by a centrifugal force and evaporation, rid itself of the oil and wear to a good old age.

There is excellent economy in the encouragement of the expert and his assistants, who are, when worthy, the prime support and king-bolt of the business. The hours of such an employé are almost undefined—undefinable. He is, perhaps, taxed beyond his endurance, and many such a man has been lost to his employer through attempted economy in riding a free horse too hard. It is, however, no trouble to supply the place of one who desires to leave a situation. The woods are full of electrical shoddy, and there are plenty of men who claim the title of electrical engineers, and sport a card showing them to be both mechanical and electrical experts. They generally have a place—they call it a position—where a plant is run on an assumed economical basis. Usually these do not last longer than to have made themselves unduly expensive to their employers.

Outside men, too, are often weighed in the balance, and found wanting. It is competent for an employé in electrical work to do almost irreparable mischief, and yet not be aware of the fact. There is no gauge by which his claims to knowledge and experience can be measured, except by trying him. The only way I can see to govern this difficulty is to put a thoroughly competent, reliable man over these bell-hanger and shoemaker electricians to watch and discharge them. The watchful eye of a high-priced man for foreman or superintendent has saved many a dollar to the contractor, which would otherwise have been paid after the plant was supposed to be finished, and before it was accepted.

An extraordinary demand for labor always brings to the front a class of men as unskilled as it is unscrupulous—men who never get up to their maximum of speed until about supper time. Practical electricity is suffering to-day from the wisdom of men who talk learnedly of "galvometers" and "computators," and seem to think that an insulator, like a tumbler, is most likely to be of some service when placed with the open end up. Yet, the theoretical without the practical ability and education, is no better. It would be poor economy indeed to depend solely on what the expert may have learned in books or at the institute. Two cases contrasted will illustrate my position.

A young man who is at present in a position of considerable importance, in addition to a small amount of education theoretically, had combined with this a practical experience in handling circuits and dynamos A combination of circumstances, such as you all know by experience, called all the experts away from the job—which was a new plant of considerable pretensions—just as it was about ready to run. The engine was started, but soon after the lights were switched in the dynamo showed an imperfection which rendered it utterly useless. The time for the grand opening was fast approaching, and there was no other dynamo to be had there, while the factory was so far away that to get one was impossible. The trouble lay in the fact that the centrifugal force of the armature had thrown the insulation between the commutator sections out just far enough so that the brushes touched only occasionally. With a very fine file he dressed down the projections, and with another tool, improvised from a second file which he ground down, he burred the edges of the sections to prevent a recurrence of the trouble, started his machine and made the opening run with perfect success, and ate his supper the next morning. That kind of a man is a jewel at any price.

A contrast of this is a case where the hero is a graduate of an eastern college, who has himself been a teacher, but he is only a book electrician. The construction of a central plant has been placed in his hands, he being the electrician of the locality, which is situated in one of the Northern States. Reasoning, apparently, that a wire which is covered with a material which the books he studied said was an insulator, that should settle the question, and consequently he said in effect: "No glass or porcelain can be necessary. To purchase these will cost more than staples, so we will use staples." If the fire department and the underwriters keep hands off until that plant is fully under weigh, there will possibly be some fun right near home.

The day of dark, dingy, unhealthy and damp dynamo rooms, with their dangerous surroundings, is fortunately fast passing away. The false economy which induced the selection of such sites has become self-apparent. It has become the rule to prefer clean, light and airy rooms, and an occasional crank on the subject has even gone to the extent of kalsomining and painting the walls, timbers and ceiling. The great advantage, however, in the latter day dynamo room, is the safety which comes of distance from the ground. I look upon the omission, in these days of progress, of any possible safeguard against danger to property or person, as criminal, as contrary to the principles of true economy, and extremely impolitic. The public is not near-sighted, nor is it either tongue-tied nor weak in the lungs.

There is an expense attending the change of a circuit or the removal of one, often a no inconsiderable expense, the saving of which may not always be true economy. I refer to the common habit of allowing wires to remain after the change is made, and thus become "tramps"—homeless wires. These vagabonds, whether No. 6 underwriter, or No. 18 annunciator, are capable, like other tramps, of unlimited and incalculable mischief. It is not directly in the power of the electric light man to control the telephone and telegraph and ticker people, but he can, and should, for his own good, gather up the remnants of discontinued circuits and clear himself as far as possible from chance of blame. The public jumps at conclusions, and right or wrong, there must be a cause given at once for every abnormal condition of affairs, every untoward circumstance, or otherwise the people's greedy appetite for sensation is unsatisfied.

It is questionable if more is not lost than gained by running incandescent lamps above their proper pressure, with the idea of obtaining more light. The increased light thus obtained is indeed great, proportioned to the increased pressure, but the life of the lamp is alarmingly shortened. It is better to run a volt or two below than a volt above normal pressure.

It is false economy to purchase cheap lamps, which consume more current in the production of standard candle power, rather than to buy lamps of higher efficiency at more advanced figures. In addition to the fact that an efficient lamp is an able economic lieutenant to the coal pile, the sizes of wires needed may be less, other things equal, with an efficient lamp. And, of course, as a natural consequence, more lamps may be used to a given number of square millemeters of conductor, and more lamps can be run from the same generator.

Cheap lamps too often go upon the same circuits as the better ones, and want of uniformity of voltage throughout the plant is the natural and unfortunate result. This condition, of course, is only found on isolated plants, but it is worth considering as an argument against the peddler of inferior merchandise. Inferior lamps are poorly constructed, the candle power and voltage are not measured by proper instruments and methods, but are guessed at by the eye, and no two consecutive lamps are similar as to candle power under the same pressure.

In connection with this matter of lamps, a method of keeping track of lamp renewals has been shown me, which is claimed to be giving excellent results. The plant where this plan was inaugurated is one of magnificent distances—some three miles separating the extremes of the territory occupied. The company's contract with its patrons is to renew only such lamps as have burned out. All broken globes are paid for by the patrons. The company places at regular stations—usually in drug stores—a few lamps, with a blank, ruled for particulars as to size, price, date, etc, and a receipt to the custodian, for lamps delivered. The depositaries are visited weekly, and settlements made. The advantages of this plan must be apparent to all. The consumer buys his lamps as he needs, without having either to go far, or keep a considerable number on hand, and the managers are enabled to discover a weak spot in the system if the breakage is excessive at some particular locality. This plan has been in operation something over a year, with the most satisfactory results to all parties concerned.

In conclusion, the prosecution of electrical enterprises is like that of almost any other business, and will be most successful when based on and conducted with true, proven economy, when the most approved appliances and materials are used, and the best ability in each department is employed. An incompetent fireman is a very expensive luxury, a careless lineman is a drain which saps the profit account of its treasurer, while a dynamo man or an engineer who watches the clock more closely than he does the gauges or the brushes, is sure to be a heavy brake on the wheels of progress.

But where all the little army is striving, each individual with his own ability, to aid in the general success of the undertaking, when each feels that he possesses the confidence of his superiors, and that appreciation of his efforts is a stepping-stone to preferment, the current of success flows more evenly, the resistance which generates wasteful heat disappears, and the field of personal magnetism is strengthened and extended, until it permeates the entire organization.

The Electrical Investigation of the Senate Committee on General Laws.

The testimony of Mr. William H. Brown, Treasurer and Manager of the United Electric Light and Power Company, occupied the whole of the sitting of the Committee on General Laws at the Hotel Metropole on the 3d inst. Mr. Brown was questioned very closely by Senators Vedder, Coggleshall and Cantor on a variety of points, and gave a large fund of information, more especially on matters involving the desirability of having separate poles for telephone, telegraph and electric light and power wires. With regard to the number of deaths by electricity, Mr. Brown considered that the majority of them could have been avoided by ordinary care. Most of those killed were persons employed in the electrical industry, and they paid the penalty of death for refusing to put on rubber gloves, for which employés have in many cases a great aversion. Mr. Brown gave some statistics on this head from which it appears that out of sixteen deaths in New York City within the last three years from electric currents, twelve were caused by negligence, the rest resulting from accidental contact with the wires. There was hardly any other cause of death the list of whose victims did not compare unfavorably in point of numbers with that just quoted, and in the three years there were 4,500 deaths in New York City from accidental causes other than electrical. In discussing the overhead and the underground systems, Mr. Brown gave the preference to the latter. Its first cost was greater than the overhead system, but in the long run it was just as cheap and possessed many advantages, notably that it afforded the ability to effect an insulation of the wires that could not be maintained above ground.

In comparing the high and low tension current systems the witness showed that on a given circuit the company he represented would use only 75,000 volts as against a million volts required by the Edison system on a corresponding circuit, and he commented on the dangerous results that the relatively high leakage involved in the use of the latter would induce The Brush arc light used by the United States Illuminating and Brush companies carries a current of 1,800 to 3,000 volts, but a system of conversion is being adopted by which the full efficiency of this voltage will be retained, and the danger to life and property very appreciably diminished.

Mr. Brown said he was in favor of legislation that would lead to the control of the electrical industry in such a way as to insure safety to life and property; but not restricting the new enterprise, or in any way retarding its benefits, or depriving the public of the great advantages resulting from it.

The popular outcry, the witness stated, about electricity being responsible for recent explosions in the subways, was utterly unfounded. In the Nineteenth street and Broadway explosion the electric wires in the manhole had no current on, and after the blow up at Fourteenth street and Sixth avenue the cables carrying the electric light wires were absolutely uninjured, and the lights remained burning. When questioned as to his view of the desirability of legislation being brought to bear on the question of the ventilation of the subways, Mr. Brown said that he considered that the law of self-preservation and commercial instinct so palpably dominated the situation that legislation on that point would be unnecessary, and the same considerations which would dictate the thorough and systematic ventilation of the subways would lead to the instant adoption of any better practicable remedy for the gas difficulty that might at any time be devised. So far as he knew, the Board of Electrical Control had never sent to make an official inspection of the wires at his company's station, with a view of ascertaining whether they were in accordance with the rules and regulations of the board. He was under the impression that each company looked after such matters for itself. With regard to many points, he was of the opinion that more stringent rules should be enacted in the matter, for instance, of the erection of poles in country towns, where sufficient attention is not paid to strength and other desiderata, and where the whole affair is very much a matter of go-as-you-please.

When asked if his company had in use any safety device whereby the current would be cut off in case of the breaking of the wire, Mr Brown said they had such a device, which was applicable to their new arc light apparatus, and was being applied also to the direct current. There have been two or three persons working on such a device, and the results given by tests of these on the lines of the company have been very satisfactory.

At this stage of the investigation Mr. Gibbens rose, and by permission of the committee put, as a citizen, a series of well-considered and pertinent questions to the witness on the stand. The answers to these interrogations went to show, as the ready ex-commissioner intended they should, the desirability of establishing over the gas and steam pipes something like the rigid supervision which is to be exercised over the electric light wires. In response to Mr. Gibbens' questions, Mr. Brown said he remembered being present at a meeting of the Board of Electrical Control last year when Mr. Gilroy declared that there was no regulation in the city of New York for controlling the leakage of gas: that his authority over the gas companies began and ended with seeing that they put back pavements they had occasion to take up in their original condition, and that he had no power to compel the gas companies to keep the joints of their mains tight. He recollected also that on that occasion a well-know expert stated that in Pittsburgh, where the pressure from natural gas is much greater than the pressure from the manufactured gas of this city, so much attention had been paid to the subject and so much care taken, that the leakage had been reduced to one fifth of one per cent. He recollected also that the president of the steam heating apologized for the state of the steam heating pipes and stated that it was owing to a mistake of his engineer, who, in putting down the pipes had used wooden wedges instead of metal ones, and that this simple mistake would take several hundreds of thousands of dollars to rectify. He was also aware of the fact that such an improvement had been effected in that service that electric light wires were now working in places where formerly the steam made their use impossible. The witness said he had not forgotten either, that the president of one of the gas companies claimed that his company had a "right to leak" in the streets because it was there first.

Mr. GIBBENS: Do you think it is fair to the electric companies and the subway companies who have to do business underground in this city, that the gas companies and the steam companies should not be under some public control, so that their dangerous commodities should be kept within their pipes, so as not to interfere with other interests?

Mr. BROWN: I go a little farther, Mr. Gibbens. I believe it would be for their own interest if some measure of that kind were adopted.

Mr. GIBBENS: I should like to know what would become of the electrical industries if they allowed their commodity to become as offensive to the public as the gas becomes.

Mr. Gibbens here rested for a brief period from his labors, but on Mr. James H. Seymour questioning the witness as to the advisability of the city building subways and letting them out to various companies on its own account, the ex-commissioner promptly rose and asked the witness whether he thought the city had any more right to embark in the business of building and renting subways than in that of running horse cars and renting houses, and whether he remembered that a bill to authorize

the city to build subways was sent two years to the Legislature by a Mayor of this city named Hewitt; and that the bill was withdrawn because the corporation counsel advised that the city had no right to embark in a purely commercial enterprise. The witness said he knew it was withdrawn, but he never knew the reason why. "Well, that was the reason," placidly remarked Mr. Gibbens as he resumed his seat.

Senator Coggeshall caused much amusement by suggesting that the $15,000,000 intended for the international fair should be used by the city for the acquirement of the subways.

The committee adjourned until Friday, March, 14.

The Brooklyn Electrical Society.

There was a large gathering of persons interested in electricity at the Brooklyn Institute on March 6. In a few words Prof. Franklin W. Hooper, secretary of the Institute, explained the purpose of the meeting. He said the attention of the Institute had been drawn to the necessity of providing an electrical department, and the only fear they had was that it might in some way interfere with the department of physics, that is to say, draw away from that department some of its present members. That fear, however, was well nigh past and the probability is that every member of the electrical department might be regarded as so much gain to the department of physics, the study of which is so closely allied to that of electricity. "Now it is one thing," said Prof. Hooper, "to form a department and another to keep it going. If you form a department of electricity, it will devolve upon you to see that it is maintained in a creditable way. Some will be contributors, and some observers, but there must be enough active members to keep the department in successful operation." The board of directors had therefore called this meeting for the purpose of ascertaining the sense of the members of the institute and those interested in electricity, and to take steps for organizing forthwith.

Professor Hooper then described briefly the rapid development which has taken place in the plan and scope of the Brooklyn Institute during the last two years. On Feb. 11, 1888, the Institute had no members but life members, who had had no meeting for 20 years. It was necessary to scour the directories of the two cities to find them; and then only 65 out of 130 life members were found. A new work was then begun, and in 12 months 12 departments were organized, each of them holding monthly meetings, with an average attendance of 20. There are now 17 departments, the membership of which ranges between 50 and 350. Each department meets at least once a month, some twice, and some have five or six meetings in the month, and the Institute has already under way the formation of five other departments, so that shortly there will be available 22 departments, each of which forms a separate society.

What the Institute wanted was a society corresponding to the New York Electrical Society, which was doing such excellent work in New York, and the programme of the institute would not be complete until such a society was formed. They wanted a Brooklyn Electrical Society. Such a society would throw life into the department of physics, and within a very short time lead to the doubling of its list of members. "The Brooklyn Institute," said Prof. Hooper, "has taken hold of the scientific impulses of this city, of its art impulses, and of its literary impulses, and will make itself a great intellectual force." The speaker stated that a membership of 100 could be reckoned on as soon as the department of electricity was fairly organized, and of 300 within six months. The dues of those coming in now would be $5, afterward $10—$3 of which would be devoted to equipping an electrical laboratory. A room would be provided where 20 young men could meet every night in the week for electrical experimenting. A weekly course of lectures would be given, in which electricity would be treated branch by branch, and topic by topic. In the laboratory every facility for experiments would be provided, and a director for organizing and directing the experiments.

Prof. Hering was voted to the chair, and the work of organizing the department was taken in hand. A large number of persons in the audience gave in their names for nomination as members of the new society, and a committee of seven was appointed, which will meet for further action at an early date.

The Argument on the Right of the City to Transfer the Business of Building the Subways.

The Supreme Court was crowded with an imposing array of legal celebrities and representative electric light men on the 5th inst. The Manhattan Electric Light Company, the East River Electric Light Company, the Northern New York Electric Light Company, the Mount Morris Electric Light Company and George E. Armstrong, taxpayer, moved to have made permanent the injunction granted by Judge Patterson against the Mayor, the Board of Electrical Control, and the Consolidated Telegraph and Electrical Subway Company, restraining the Mayor and the Board of Electrical Control from authorizing the transfer by the Consolidated Company of its rights and property to the Standard Company or any other company, and enjoining the Consolidated Company from making such transfer.

The case was argued before Judge Andrews. The protesting companies were represented by Elihu Root and DeLancey Nicoll, and W. B. Putney appeared for Mr. Armstrong. The interests of the Consolidated Company were in the care of Edward Lauterbach and William N. Cohen, and those of the Standard Company to Wheeler H. Peckham. W. Bourke Cockran and Paul D. Cravath watched the case on behalf of the United States Illuminating Company and the Brush Electric Light Company, and the Mayor and the Board of Electrical Control were represented by D. J. Dean.

In opening the case, Mr. Nicoll dwelt on the vital importance of the issue of the contention to the plaintiffs. They were simply fighting for dear life, for if the proposed arrangement were carried out they would inevitably be driven out of business. Mr. Nicoll went into the history of the subway contract, and recited how the Board of Electrical Control was created by the State Legislature in 1884 for the purpose of carrying into effect an underground subway system. Having evolved such a system they contracted with the Consolidated Company in 1886 for its practical working, and this contract was ratified by the Legislature in the following year. The terms of the contract were that the company should furnish the capital and give suitable bonds for the faithful carrying out of the contract. Thirty miles of subways have now been built under that contract.

A system of rules was adopted by the Board of Electrical Control for the conduct of the subway work and the adjustment of the relations between the subway company and its tenants. On these rules to a great extent hinges the present issue, for if the proposed transfer is made they will constitute a menace to the existence of the plaintiffs, whose rivals the new Standard Company are. According to one rule, the subway company shall keep the keys to the manholes; another rule enjoins that application for space must be made to the subway company; and another that subsidiary connections can be made only by the subway company. These restrictions which were reasonable and just when exercised by a friendly company, became in the hands of an adverse interest a crushing power which practically meant the shutting out of any uncongenial interests. In the present keen fight between the continuous current and the alternating current systems, if the exploiters of one system gained control of the subways, and the users of the other system became their tenants, it was not hard to tell what would happen. Mr. Nicoll divided the electric light interests of the city into three classes—the Edison Company, the right to build subways for which is reserved by the Consolidated Company; the Westinghouse interest, which controls the Standard Company, and which includes the Brush Electric Light and the United States Illuminating companies; and the companies other than the Westinghouse combine, for which companies he appeared.

Mr. Nicoll commented on the fact that though, up to January 1890, the Consolidated Company insistently maintained its exclusive right to the building of the subways, after that time, for some mysterious reason, it began to change its tone, and when the ready permission of the Board of Electrical Control to divide its hitherto exclusive prerogative was accorded at a recent meeting, it was very evident that some influence had been at work which made this permission assured. As an indication of the confidence displayed by the Standard Company in being able to successfully and completely overcome all opposition to its plans, Mr. Nicoll read a prospectus of the company, issued on Jan. 14, 1890, in which its programme was set forth.

The learned counsel closed his argument by contending that so far the Standard Company existed only on paper, and "It exists at present simply to get this contract if it can. It is controlled by the two great Westinghouse Companies, and if they get control of the subway system, all rival companies might as well put out a red flag and sell their assets at auction. Now, we claim that the Board of Electrical Control has no power to make another contract, because there has not been a breach of the contract made with the Consolidated Company. If it has the power to make another contract, it has not the power to authorize the sale or transfer of the subways constructed by the Consolidated Company. The execution of this new contract would be a waste of the rights and resources of the city of New York."

W. N. Cohen, speaking for the Consolidated Company, said that the question of their motives in selling their subways was none of Mr Nicoll's business. Their money had built them, and they had a right to dispose of them as they saw fit. The case was similar to that of a tenant who tells his landlord that he shall not sell his house. If, however, the building of the subways had to pass into other hands, the subways already built must also be transferred to avoid conflicting responsibilities. With regard to the contention of the plaintiffs that they will be hounded to death under the new conditions, it was only necessary to recall the fact that the rules controlling those conditions were made by the Board of Electrical Control, and could at any time be changed by the same authority, which would promptly restrict anything like injustice or undue advantage.

Mr. Dean contended that the Board of Electrical Control had the power, under the provisions of the subway laws, to make new contracts, if the existing contract becomes ineffectual. The Consolidated Company had been proved to be unable to do the required work; the old contract had therefore been invalidated, and a new contract was demanded by the interests of the city.

Mr. Bourke Cockran followed with a statement that the entire proceeding was simply an attempt on the part of the Manhattan Electric Light Company to extort money from the new Standard Company, and to prove it, he presented the affidavit of C. H. Jackson, president of the Standard Company, to the effect that the Manhattan Company had demanded to be bought out for $1,200,000, while their property was worth but $600,000.

On the following day, on the sitting of the court, Mr. Root put in an affidavit from Mr. Bernheim, of the Manhattan Company, denying the accusation made by Mr. Bourke Cockran the previous day.

Mr. W. H. Cohen and Mr. Peckham took up the argument for the Consolidated and the Standard companies, respectively, and Mr. Root closed with an exhaustive and lengthy recapitulation of the arguments already advanced by Mr. Nicoll, and said:

"This is simply a scheme to monopolize the subways to the benefit of the Westinghouse interests and the exclusion of others. Place the control of the subways in the hands of this new power, and we will suffer a death more cruel than that which the Westinghouse dynamos inflict."

Judge Andrews says it will be a week or ten days before a decision on the argument can be rendered.

The Distribution of Electrical Energy Over Extended Areas in Mines.*

BY ALBION T. SNELL, ASSOC. M. INST. C. E.

The results obtained in pumping and hauling at St. John's Colliery, Normanton, and in numerous other pits in Great Britain, Germany, France and America, have at last been recognized as commercial successes. And it may now be fairly assumed that electricity is one of the recognized means of transmitting power in mines. The writer thus feels justified in carryingthe subject a stage farther. He proposes to examine the different methods by which electricity can be applied to mining operations on a large scale. For it is evident that, if electricity is to be applied to general purposes, so as to thoroughly compete with compressed air systems, the power must be distributed in such a way that a number of motors can be supplied off the main cables. With the single exception of the dip-pumps at Andrews House Pit, no attempt has been made in Great Britain to lay out for underground work a parallel motor system, *i. e.*, one in which a number of suitable motors can be coupled at pleasure to the mains, without reference to each other or to the source of supply. (Since writing this paper arrangements have been made to extend the plant at St. John's Colliery. The addition will be made with a view of a complete parallel system in the future.) This is so, not on account of any electrical difficulty, but simply from commercial considerations. The cautious conservatism of which the British as a race are justly proud has usually limited the installations to a single motor and the necessary dynamo. Hence the electrical engineers have chosen the cheapest and most suitable method of design for a single plant, viz., a series-wound dynamo and motor. This arrangement gives, in addition to simplicity, the important property of nearly constant speed of the motor, if the dynamo be kept running at a uniform rate. This elementary system of installation has done yeoman service in the past, and will still be of use for isolated plants; but the time has come when a more general solution of the problem of electrical distribution in mines is required. Fortunately, there is no need of special experimenting in this direction. The experience gained *above ground* in the supply of power by electric motors is sufficient to satisfy the most exacting conditions of *underground* work, And it is only necessary to modify the methods hitherto used to suit the new conditions.

Electrical distribution of power is accomplished in two distinct ways. The first is made by a continuous current. The second is made by alternating currents. Hitherto transmission of power has, with a few exceptions, only been accomplished commercially by continuous currents. The writer will therefore first discuss the systems involving direct currents. These methods are in general use, and may be distinguished under the following heads:

1. *Single transmission* by series-wound dynamo and motor. Both C and E are variable.

2. *Constant current transmission*, applicable usually to one dynamo and a number of motors, all running in series with each other. C is constant and E variable.

3. *Constant potential transmission*, comprising in its simplest from one shunt or compound-wound dynamos, and a number of series, shunt or compound-wound motors. E is constant and C variable.

To properly understand these methods of distribution, which are likely to obtain in the immediate future of electrical distribution of power in mines, it will be necessary to distinguish between the different types of machines, and to understand the characteristics of each system of winding.

The *series winding* is chiefly applicable to a pair of machines. It is most useful where the motor shaft is required to run at a constant speed, irrespective of the load. This winding also gives the greatest possible torque or turning moment at starting. These are most important points in many cases, notably the pumping and hauling plant at St. John's Colliery, in which the motors have to start against the load of the column and the weight on the two ropes, and also have to maintain approximately the same speed whether the hauling ropes are on or not. With the series system, two or more pairs of machines may be coupled to the same work mechanically, but the electrical connections must be independent. The Normanton plant is arranged in this manner, The two dynamos are driven off the same engine, and the motors are coupled by belts to a common shaft, but each pair of machines is connected by a separate cable.

The *shunt winding* is adapted for giving a fairly constant difference of potential or electromotive force with a varying current.† It is consequently suitable for a dynamo which has to supply a number of motors running independently of each other, with or without varying loads. If the motors are to run at fairly constant speed with varying loads on such a circuit, they must also be wound in shunt. If they are required to work with a constant torque, say, pump-driving, a series winding may be used with advantage. The "Andrews House" installation is arranged in this way. The dynamo is shunt-wound and the motors are series-wound. It is practically impossible with the shunt system to maintain a constant difference of potential at any given point—a matter oftentimes of no little importance. Every variation of load means a difference in the quantity of current flowing in the main cables; and although the dynamo may maintain practically the same electromotive force at its terminals, yet since the number of volts lost in the cables is proportional to the current, the tension at any given point must vary directly as the current difference. And since the speed of a series-motor running with a constant torque is directly proportional to the electromotive force of supply, this variation of tension means a corresponding difference in the motor speeds. If a shunt-motor be used the speed will not vary so fast as the electromotive force, but yet the speed is roughly proportional to the tension. Thus, supposing we have a shunt-dynamo on the pit-top giving 250 volts at its terminals and supplying motors at various parts of a mine with, say, a maximum current of 100 ampères, distributed according to the work, as in Fig. 5, and let the cable resistance to the first distributing center be .25 ohm, then the number of volts lost under these conditions up to this point will be, $C\,R = 100 \times .25 = 25.0$ The speed of the motors, neglecting further loss in sub-mains (and other disturbing influences) will be proportional to $250 - 25 = 225$ volts. Now, assume that one-half the work be taken off, and the current required be only 50 ampères, the tension at the distributing box will be now:

$$E - C\,R = 250 - 50 \times .25$$
$$= 250 - 12.5$$
$$= 237.5 \text{ volts,}$$

and the speed of the motors will be roughly proportional to this figure, viz.: 237.5, or, the speed will be increased in the ratio of

$$\frac{237.5}{225} \text{ or } 5 \text{ per cent., approximately.}$$

This is not a very serious alteration of speed, but in practice the motors at the extremities of the system would be affected to, say, 15 per cent., or even 20 per cent., through other losses. This shunt-winding is not adapted for motors which have to start against a very heavy load, since the torque they can exert, when run off a series dynamo, is a minimum when they are at rest. You will remember the series-winding under the same conditions gives a maximum torque. If a shunt motor be driven by a shunt dynamo, the torque at starting is theoretically a maximum, *i. e.*, assuming the value of the electromotive force of supply is maintained. Practically, the tension always falls when the circuit is closed, and it may be so much as to prevent the motor from starting on full load. The ideal method of winding the dynamos for a general system of distributing power is a combination of the series and shunt methods. It is called *compound-winding*. The chief advantage of this winding over the pure shunt is that the ratio of

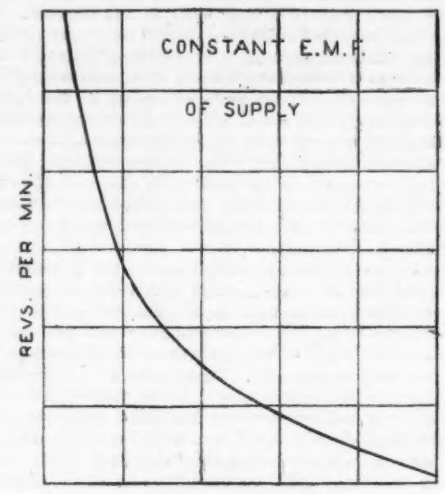


Fig. 1.—Series Motor.

series and shunt effects can be arranged to give an approximate constant difference of potential at a point distant from the dynamo terminals, such as the distributing box in Fig. 5. A dynamo thus wound is said to be over-compounded. An approximation to this regulation can be made by using large shunt dynamos and very heavy copper mains; but, probably, for most cases of mining work, the compound-winding will be preferred, since smaller mains can be used.

Characteristic Curves of Dynamos.

The writer thinks that an explanation of the "characteristic curves" of the different types of machines referred to will be only a logical conclusion to the preceding general statements, since without some knowledge of the properties of dynamos and motors a proper appreciation of the capabilities of electrical machinery is impossible. On inspecting the curve of a series machine, it is apparent that the output of the dynamo is strictly proportional to the work required. There is no waste of energy when running light. Assume a load on the motor requiring 20 ampères, the number of volts corresponding is 275, or an output of 5,500 watts = 7.4 horse-power nearly. Now let the torque increase to 50 ampères, the volts will be 425, the watts 21,250, and the horse-power 28.5. If the load be *nil*—that is, if the circuit be opened—the ampères and volts are *nil*, and consequently the output is also *nil*. This is a most important feature in electrical transmission and is one of the reasons why the coal consumption is always small with a well designed plant. The series type of dynamo is only used to drive one motor, also series-wound. The chief point to note with regard to the external characteristic of a shunt-wound dynamo, running at constant speed, is the large possible variation of current for a relatively small difference in the value of the terminal electromotive force. Hence, a number of motors could be run off such a dynamo and have their loads varied within wide limits without largely affecting the speed of each other. It will be noticed that if the load be raised so that the work corresponds to that part of the curve which is vertical, the electromotive force rapidly falls, and if the load be

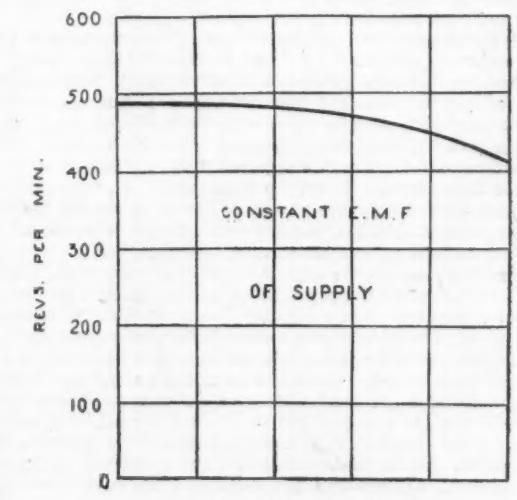


Fig. 2.—Shunt Motor.

maintained there is risk of the current falling away to zero. This would obtain in practice if the motors were to be overloaded. This explains why a shunt dynamo is not suited for running motors which have to start against heavy loads. (Special arrangements can be made to modify this peculiarity in some degree, such as first exciting the motor field and then closing the armature circuit through a resistance.) The external characteristics of a compound-wound dynamo shows that the electromotive force can be made practically constant throughout the limits of the designed current variation; or, it can be arranged to any desired slope. This is the type of dynamo which, in a properly modified form, the writer believes will be used for supplying power over mines in the immediate future.

Motor Mechanical Characteristics.

Motors have also their characteristics, but they are of less importance to the present subject, and they also require a better acquaintance with motor work than is assumed here. Reference, however, will be made to what are called "mechanical characteristics," *i. e.*, curves showing the variation of speed for different values of torque or work per revolution.

Fig. 1 shows this relationship in a series-wound motor, supplied with current at constant electromotive force. Note that the work per revolution is a maximum for a minimum speed, *i. e.*, at starting. Fig. 2 gives the result with a shunt-wound motor. Note that the work per revolution varies largely for relatively small differences of speed. If the load were pushed beyond the limiting value of current shown in the diagram, the curve would rapidly drop; but, assuming the potential difference to be maintained at the terminals, the motor would not stop till the current

* Abstract of a paper read before the Federated Institution of Mining Engineers of Great Britain, Sheffield, January 22, 1890.

† In practice, the terminal E. M. F. will vary about 10 per cent. to 15 per cent. at least between no load and full output.

in the armature circuit was equal to the terminal volts divided by the armature resistance. The torque then would not be so great as that possible with a series winding, since the field excitation would be approximately constant through the range of the curve. (Practically it is not possible to maintain the motor terminal electromotive force constant, owing to the fall of potential in the leads. This causes a proportionate weakening of the field as the load increases.) In the series motor both field and armature are temporarily strengthened at starting. Fig. 3 gives the same with a compound-wound motor. Note there are two ways of coupling up the two

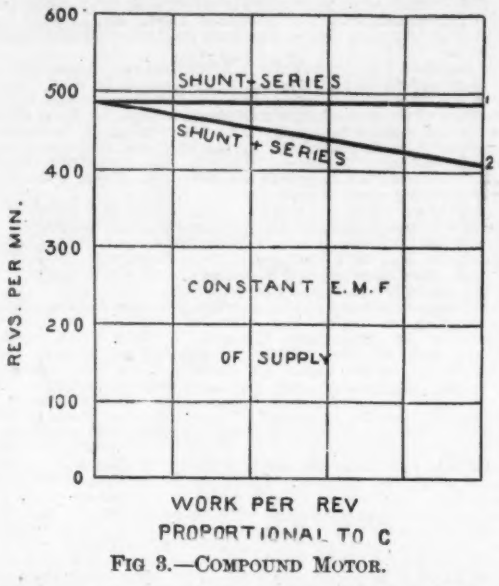


FIG 3.—COMPOUND MOTOR.

field windings. In curve I. the windings are differential, *i. e.*, the series coils magnetize the field in the opposite sense to the shunt. This arrangement gives a nearly constant speed throughout the limits of the design. If the machine be overloaded, the series coil is likely to neutralize the shunt effect, and the motor will stop, and may even reverse. This type of motor thus is not adapted for starting against heavy loads, but may be used where regularity of speed is of paramount importance. Sometimes the coils are wound so as to add their effects. The result is shown in Curve II. This winding does not give such a uniform speed as the pure shunt-winding, but since the series-coil is cumulative and not differential the motor will start against a fairly heavy load, and will maintain a speed sufficiently uniform for most purposes between the limits of the design. Some care is required in starting motors of these types. In these three diagrams the abscissæ are proportional to either the current, the torque, or the work per revolution, for these quantities vary together.

Comparing the curves in Figs. 1, 2 and 3, it is evident that with a variable load the shunt and compound-windings are alone admissible, if a fairly good regulation of speed be desired. The series motor, when supplied at constant electromotive force, is only adapted for a constant load—say a pump or a fan—but is, *par excellence*, the machine for starting very heavy loads, as in hauling plants, with main and tail, or single ropes.

The writer has dipped thus far into the technics of electrical machinery in order to show that the question of the distribution of power by electricity over large areas in mines has been already studied, and presents no insurmountable obstacles to those responsible for the erection of such plants. It will now be convenient to examine a little more in detail the three methods of distributing energy by direct currents, and to summarize the properties of each.

I.—SERIES-WOUND DYNAMO AND MOTOR.

Mention has already been made that this arrangement is only suitable for a pair of machines, that the motor exerts a maximum torque at starting, and maintains a nearly constant speed between the limits of the designed load if the dynamo speed be kept uniform. It is necessary to refer again to the last-mentioned peculiarity of this system, viz., the constant speed. In Fig. 4, Curve I. shows the variation of electromotive force with the current in a series dynamo running at constant speed; Curve II. shows the same relationship between the electromotive force and current in a series motor designed to be run by the series dynamo; Curve III. shows geometrically the summation of the electric resistance of the dynamo, motor and cables. Now, Curves I. and II. have been so designed that the difference between any two corresponding ordinates is equal to the numerical value of the same ordinate in curve III. Also the current in both machines will always be the same, for they form one continuous circuit, and curves I. and II. were both plotted at constant speeds. Since the difference between them is equal to the electromotive force necessary to overcome the resistance of the entire circuit, it follows, if the dynamo be run at a constant speed, the motor must also run at a constant speed. There will thus be a nearly perfect regulation of the output of energy to meet the demands of the motor, and this energy will be supplied in such a manner as to keep the speed fairly constant. In practice it is not possible to obtain an absolutely constant motor speed; but the regulation can be made sufficiently near for any ordinary purposes. This system is not adapted for electric lighting, either with the lamps in parallel or in series; but a few lamps may be run with suitable precautions.

II.—CONSTANT CURRENT TRANSMISSION.

In this case, since the value of the current remains the same, variations of power can only be made by directly proportional variations of electromotive force. The system is applicable to any num-

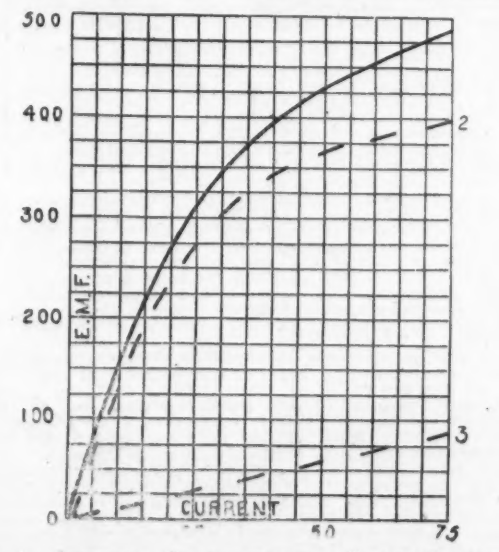


FIG 4.—INTERNAL CHARACTERISTIC, SERIES DYNAMO.

ber of dynamos and motors running in series with each other, and is theoretically only limited by the safe working limits of the tension. Since high tensions (several thousand volts) are not likely to be used in mines, there will be no object in discussing this system at length. Briefly, the advantages are a capacity for transmitting energy over very extended areas, where the power is used at widely distant points, with a moderate expenditure of copper in the cables. The chief objection, other than the high tension, is the necessity for a governor of some form to each motor, and probably to the dynamo or dynamos also.

This system, however, is useful in particular cases. The writer has recently designed for Messrs. Immisch & Co., two motors to run on a constant current circuit of 10 ampères and about 2,000 volts. Each motor will develop about 10 b. h. p. at a speed of 800 revolutions per minute, and will absorb about 1,000 volts. These machines will each run a set of three throw pumps, with 3-inch rams of 9 inch stroke. Each pump will raise water against a vertical head of about 750 feet, making a total lift of 1,500 feet, with a 4-inch rising main about 1,500 feet long. The dynamo is an arc lamp machine, and will be used for lighting at night and running the motors by day. These motors are fitted with high speed centrifugal governors which vary the value of a shunt coupled to the field terminals. The speed of the motors for a given torque is adjusted by a spring on the governor. Since the load on the pumps is practically constant, the governing device will only be used in case of accidents, such as a clack getting off its seat, or a failure of the suction. If, however, the load were to be frequently varied, the governors would keep the speed between the arranged limits. There is not much demand for constant-current motors at present, nor does the writer think they are likely to come into general use. They are chiefly adapted to arc lamp circuits, in which they run either in series with some of the lamps, or they are only run by day when lighting is not required. They may also occasionally be chosen to transmit power over very widely distant centres. The constant-current system is only suitable for lighting by lamps run in series, or in multiple series, in the main circuit.

III.—CONSTANT POTENTIAL SYSTEM OF TRANSMISSION.

The features which make this system the most suitable for general distribution in mines have already been brought out when discussing the characteristics and mechanical curves of dynamos and motors. The pure shunt and the compound dynamo have also been compared, and the general advantage of the latter shown. Before referring to a practical illustration of this system, the writer will restate the practical properties of the constant potential system with compound dynamos.

1. The dynamo, or dynamos, can be arranged to maintain a constant difference of potential at any desired centre, so as to distribute energy from this centre at the same pressure, no matter how the load may vary within the limit of design.

2. Either series, shunt, or compound motors may be used on such a circuit, so as to meet the different requirements of work.

3. A suitable unit size of dynamo being chosen to start with, the plant can at any time be increased by the addition of one or more dynamos. All of these dynamos can be coupled to the omnibus mains, and will deliver electricity in proportion to the required output; just as two or more engines can be coupled to the same shaft, or several compressors can be used to charge a common receiver or service pipe.

4. Various sizes of motors can be run on this circuit if they are wound for the same electromotive force. Thus a 50 horse-power motor can be used for hauling or pumping, a 2 horse-power motor for rock drilling, and a 10 horse-power motor for coal-cutting.

5. Power can be rapidly taken to any part of the pit by running temporary cables from the nearest distributing centre, and any of the motors can be connected. This facility for rapid work in the case of breakdowns, temporary feeders, and perhaps, with certain precautions, sudden outbreaks of gas, will be of marked importance in the near future. Indeed, the electrical distribution of energy by the parallel system has all the flexibility of compressed air, steam, or water systems, with the further advantage of cheapness, high efficiency, and freedom from bad breakdowns.

6. In case of accident to any part of the system, the damaged cable or machines can be easily disconnected from the mains without affecting the rest of the plant.

7. Incandescent or arc lamps can be run off the mains at any part of the circuit. The parallel system meets equally well the requirements of light or power. The importance of this will be generally admitted.

The chief drawback to the parallel system is the cost of the copper mains, if a relatively low tension of supply be selected so as to run small as well as large motors. The writer proposes the following scheme to meet this difficulty in distributing energy in mines:

Fig. 5 is a rough diagram indicating the way in which such a general system would be applied.

The details, with the exception of the cables, are sufficiently clear. *A* is the dynamo-house; *B B* distributing centres; *C C* hauling motors; *F F* pumping motors; *E* direct-current transformer; *D* rock drills and coal cutters. An arc lamp is shown on the pit top, and the stars indicate incandescent lamps at various points in the roads and workings.

Since the size of the copper for a given transmission of energy depends principally on the amount of current, the tension selected will be usually as high as possible. But there is a limit to the voltage, depending on the extent of the work area, the difference between the sizes of the motors, the insulation resistance of the system, and the general character of the roads, etc. Hitherto the writer has not used more than 725 volts below ground, and then only with separate pairs of machines. In America much higher tensions are sometimes used, but the same restrictions do not apply to the two countries. In Great Britain, with the conditions obtaining, both legal and natural, it is not likely that tensions of more than 500 volts will be used for an extended system of distribution. And even this tension will be too high for serving the motors running rock drills, coal cutters, dip pumps, and auxiliary fans. Indeed, all the larger motors near the pit bottom will be run at the higher voltage, and the smaller and more distant machines by a lower electromotive force. This lower tension will be obtained through transformers, or direct current convertors, as they are sometimes called. These will transform a small current at high pressure to a large current at low pressure. The transformer somewhat resembles a motor with two armatures. It is really a combination of a motor and dynamo. It requires no attention beyond oiling the bearings, keeping clean the commutator, etc., and adjusting the brushes. Since it has practically no strain beyond the torque of the two armatures, the wear is almost negligible in practice. These transformers could be locked up in cabins on the main in-takes. They could be inspected at regular intervals, and could be started or stopped at distributing boxes arranged at suitable spots. Transformers have not yet been used below ground to the writer's knowledge. Their utility, however, is so apparent that he expects to find them in demand before long. Their merit has already been appreciated in more than one general scheme for distribution above ground. By the proposed scheme an economy of copper could be secured in the mains and the cost of the smaller motors would be lessened. For high tension small motors are not only expensive to wind, but also uncertain as regards insulation. The cost of the sub-mains would be practically the same in any system, because it would not be practicable to use very small or very weakly insulated leads.

The use of an uninsulated *return* is very tempting, since there is plenty of old cable lying about most collieries. The writer has in several cases used iron rope for this purpose with success. But it must be recollected that the risk of possible complications by short circuits would be increased by every additional motor. Considering all things, he does not advise the use of naked returns in cases where more than one or two motors are run off the same dynamo, particularly if the tension be high or the power large. With the system here proposed there would be little objection in most cases to using a naked return on the low-tension circuits, *i. e.*, for the returns to the transformers, assuming the high-tension mains and the dynamos and motors supplied directly from these mains were properly insulated. It is necessary to note that the cost of the transformer and their erection have to be charged against the system. This extra cost will be about £8 per horse power per transformer. It has to be compared with the saving effected in the copper of the mains, and to the decreased cost of small motors. These two points should alone be sufficient to warrant the arrangement, without reference to the increased flexibility, and the safe use of both large and small motors. It has been proposed to drive low-tension dynamos off the shafts of large pumping motors, and utilize the current to run small motors for rock drills, etc. Immisch & Co. have already made such an arrangement for a Bohemian tin mine. This method is, however, not always applicable, and generally will not be so handy as a transformer system.

Transformers can also be used on constant current circuits. With such a method of distributing energy the high tension main current would probably not be used directly to drive motors in most cases, but would be converted into a lower potential current by transformers. These transformers would be placed in suitable centres for distributing power to the motors. The writer did not refer to this under the head of constant current transmission, because he believes the high-tension current necessary in the primary circuit to be unsuited to ordinary mining practice. There are some cases where, perhaps, this system would be advantageous, but the constant potential distribution is more likely to be adopted in the immediate future.

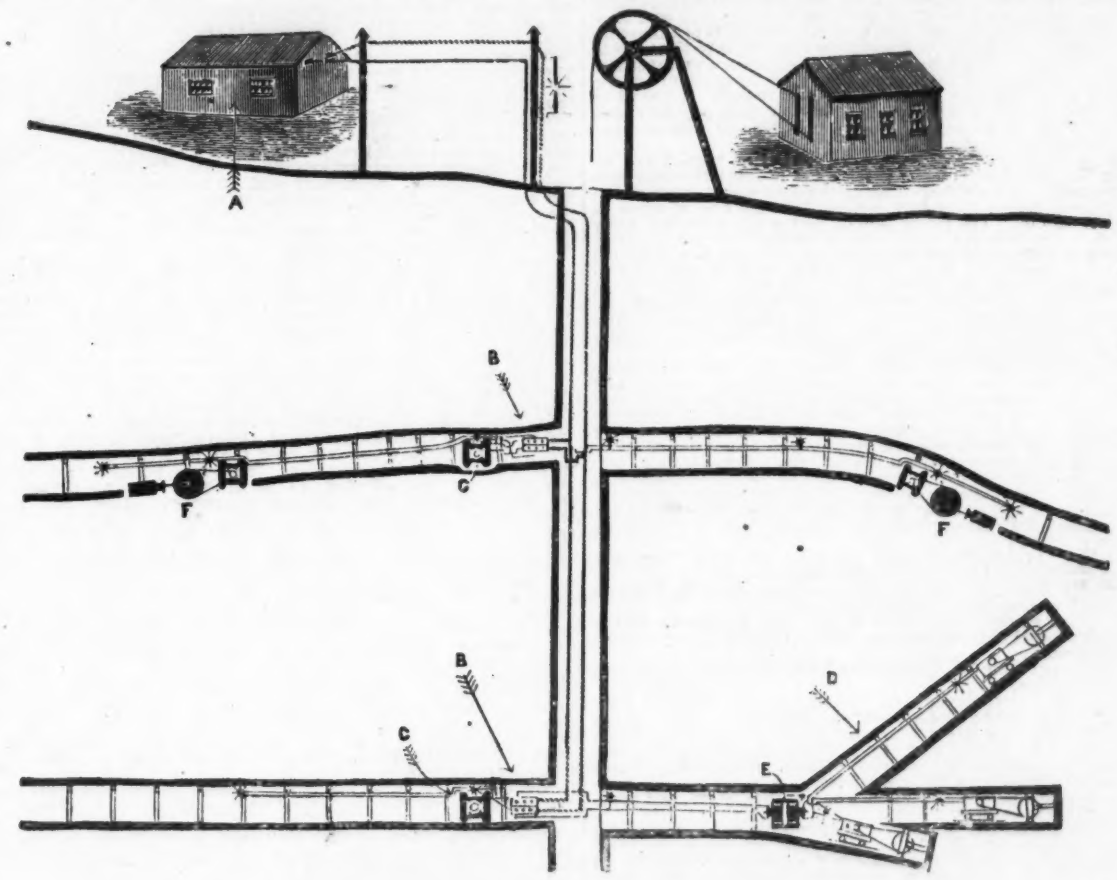


FIG. 5.—DISTRIBUTION OF ELECTRIC POWER IN MINES.

ALTERNATE CURRENT TRANSMISSION.

This paper would be incomplete without reference to the second branch of electrical distribution of power referred to under the head of "Alternate Currents." Alternate-current dynamos have been used with great success, but there are several practical difficulties in the construction of efficient self-starting non-synchronous motors, *i. e.*, motors which are both capable of starting against a large torque without extraneous help, and which also can run at speeds bearing no simple ratio to the speeds of the dynamo. Nine years ago it was demonstrated that if two alternate-current dynamos were coupled in series with each other, and both their fields were excited by an independent direct-current dynamo, that if one machine were driven the other would run as a motor, and would do work in an efficient manner; but the speed of the motor had to synchronize with that of the dynamo, or it would stop, and it could not be started again without first slowing the dynamo and starting the motor by some independent means. Then as soon as the two machines got into step, as it is technically called, the motor would exactly follow all the variation of the dynamo rate of rotation. Such a system of transmission, although possessing a remarkable power of self-regulation, and a high efficiency of conversion, is only adapted to a pair of machines with separate exciters, and necessitates some device for starting the motor (such as accumulators). It may pay in cases of transmission of energy from distant water power, but it is not applicable to mining work in general at present. Rapid strides are being made in this branch of electrical engineering, and it is not safe to predict anything. At present we have a few self-starting alternating motors, some made synchronous after a certain speed is reached, and others always non-synchronous. All of these, however, seem to be rather experimental. The writer does not know of one giving an efficiency of more than 50 per cent. to 60 per cent. at the best. This type of motor is capable of parallel running, of almost perfect speed regulation, and, moreover, in some forms has no brushes, so that there is no sparking. Alternating-current distribution systems will certainly involve transformers. These, however, contain no moving parts, and are so far preferable to the direct current transformers. There are advantages and also disadvantages attending the use of alternate currents, but it would be inconvenient to discuss them here. This brief allusion must be sufficient for the present.*

In all that has been written in this paper the writer wishes it to be distinctly understood that the danger likely to result from the use of an unprotected motor in an explosive atmosphere is not glossed over. In metalliferous mines and those coal seams which are free from gas there can, of course, be no need of any particular care in selecting the site of electrical machinery. In most collieries the "in-takes" are safe enough, although the "returns" and "faces" may be dangerous. In most of such pits there would probably be little, if any, risk with fixed motors for haulage, pumping, etc., on the main "in-takes." For, assuming a sudden outbreak of gas, before the main air-way could be fouled the motors could be stopped, and having once opened the switches all danger from this source would be at an end. There are pits in many parts of the country where naked lights are used in some of the roads and workings, and protected lamps in others. In these, wherever naked lights are used, electrical plant can be employed with equal safety. Speaking generally, wherever naked lights are used, electricity is not dangerous; and in pits subject to occasional outbursts of gas it can be safely used with due caution and proper ventilation of the motor-house.

* It is open to doubt whether an alternating parallel system of distribution can possibly be so efficient as a direct-current system. Certainly, judging from our present standpoint, the plant efficiency of the alternating system will be much less, and consequently the prime cost will be more.

Business of the Westinghouse Company for 1889.

At the meeting of the directors of the Westinghouse Electric Company, held on the 5th inst., P. F. Kobbe was elected treasurer, and W. L. McCullagh assistant treasurer, to fill the vacancies caused by the resignations of John Caldwell and A. T. Rowand.

The earnings and expenses of the company (including leased companies) for 1889 were given as follows:

Total sales for the year	$4,362,115.22
Cost of manufacture, including material, labor, manufacturing supplies, and all royalties paid	2,242,138.30
Manufacturing profit	$2,119,976.92
General expenses, (including repairs to factory, machinery and tools)	767,087.56
Gross profit	$1,352,889.35
Lease and rentals, (paid to leased companies)	215,555.94
	$1,137,333.31
Extraordinary expenses, patent and legal experimental, interest and discount	407,525.54
Net profits for the year	$729,807.87

NOTE.—The repairs to factory, machinery and tools, amounting to $96,135.58; also the experimental expenses, amounting to $62,146.07, have been charged out to the current year's business.

Sales for six months, ending June 30, 1889	$1,492,406.15
Sales for six months, ending December 31, 1889	2,896,769.07
Total sales for year	$4,362,115.22

It will be observed that the sales for the second half of the year are almost twice as great as for the first, which is largely due to the fact that the leased companies were not practically in full operation until the first of July.

The Practical Working of the Electrical Subways of New York City.*

Discussion of the paper read by WILLIAM MAVER, JR., at the meeting of the American Institute of Electrical Engineers, New York, February 18, 1890.

The CHAIRMAN (Vice-President T. C. Martin): I am sure we must feel extremely indebted to Mr. Maver for the very able and massive paper that he has presented to us this evening. It is a magnificent aggregation of data. And while we may not take the roseate and optimistic views that he does of the situation, we must feel that he has endeavored to present to us a truthful picture of the subways of New York City, as he knows them to-day. We shall be now very glad indeed to have a discussion of this paper; and I would like it to be as expeditious as possible, as the evening is already advanced.

Mr. CHARLES CUTTRISS: There is one question I would like to ask of Mr Maver, that is, if any great drop in insulation has been noticed between summer and winter. As you know, we have in the Commercial Cable Company a straightaway line of some 12 miles under ground. The major part of that is gutta percha. Four miles of it is the Standard lead-covered cable. The insulation of that circuit in January is generally the greatest and is about 1,000 megohms. In summer it drops to about 300. That is also observable in our sea cable between Wall street and Coney Island. That is a better line, and the drop there is from about 1,400 to 300. As most of the compounds used in the subways are either India rubber or fibre, and as ours is gutta percha, I would like to know if Mr. Maver has any data which bear upon that.

Mr. MAVER: As a matter of fact the results have shown a higher insulation of the cables since the approach of cold weather; and also in the case of new cables. But whether that is due to the cold weather or to improved methods of making the joints and more experienced workmanship, is a matter which I think another winter would have to disclose. I have, in speaking of the matter of an increased insulation noticeable at different times, thought that perhaps it was due to lower temperature, but I do not think there is as yet sufficient data to enable us to speak definitely on that point.

Mr. CHAS. G CURTIS: I would like to ask Mr. Maver if he has any approximate estimate of what the subways in New York have cost so far per mile?

Mr. MAVER: I think about $3,000 per duct per mile. I am not possitive: but I think I have heard that statement.

Mr. CURTIS: Can such ducts as they are now laying be built on the average for something like $3,000 per mile?

Mr. MAVER: I do not know positively. I did not speak by the book. I have heard that figure mentioned, I think. It may be four or five thousand.

The CHAIRMAN: I see Mr. Lauterbach here. Probably he can give us that information.

Mr. EDWARD LAUTERBACH: Of course, the cost depends very much on the number of ducts in a trench. To dig a trench and lay the concrete, and have only one or two ducts, will cost very much more per mile than it will with eleven or thirteen ducts. The precise average has not been ascertained, I think. But the figure that Mr. Maver mentioned may be looked upon as a minimum—the average cost per mile per duct would not be less than $3,000, and probably exceeds that amount.

Mr. JOSEPH WETZLER: Mr. Maver in his opening remarks stated that many people thought the underground system in its ideal form should be a tunnel, which could in the first place contain all gas, water and other distributing pipes, and in addition the electric wires, and frequently Paris is held up as the ideal. Now, as a matter of fact, Paris having that ideal system of sewerage and about to go into electric lighting, does not propose to use it at all for the purpose of distribution; and I think his remarks in controverting that idea very apt. Indeed, in Paris to-day, instead of the sewers being full of wires, as many people suppose, there are probably not more than two electric light high-tension circuits. These were laid about ten years ago, and are still in operation, but none have been laid since. Where they are going into distribution to-day, they are actually using ducts which are built under the sidewalks. So that they have come also to see that the large sewer system is not what it appears to be as a system of distribution.

Mr. W. J. HAMMER: I would like to ask what proportion of electric light wires in the subways are at present live wires?

Mr. MAVER: Well, I presume, perhaps 95 or perhaps 99 per cent. I do not think there are over 10 miles of electric wires in the subways to-day that are not in active operation. If they are not in use it is simply because they have been recently laid, and are in process of being connected up.

Mr. HAMMER: I would like to ask also if these wires are connected with the overhead system? I presume, in the case of the Stanton street station, for example, that the wires run overhead some distance from the station before they go into the subways.

Mr. MAVER: Yes; that is true. They must necessarily go into the stations by overhead wires. The subways do not extend to the stations.

Mr. GEORGES D'INFREVILLE: I wish to supplement what Mr. Wetzler has said about the system used in Paris, which is perfectly correct. They do not use any insulation at all on their wire. In fact, they do not use wire. They use bars of copper, which rest on porcelain insulators. This system is, however, not used as yet to any great extent.

The CHAIRMAN: There is one gentleman present whom I think we should hear from. I know that his native modesty keeps him quiet; and I can understand that there are other reasons why he is not particularly anxious to speak. But his work has been extensive, and so much greater than that of any one else in connection with the subways, that as one of our members I think he might give us an idea as to what he considers the results that have been obtained. I refer to our highly esteemed and highly respected member, Dr. Wheeler. I think that Dr. Wheeler has had an ordeal that very few of us would care to go through. And I think that he has come out of it with credit to himself, and that is perhaps more than could be said of a great many who were subjected to such conditions as have prevailed in this city under the regime of the Board of Political Control.

Dr. SCHUYLER S. WHEELER: Mr. Chairman, unfortunately I arrived here just as Mr. Maver was concluding, and I am not acquainted with the matter contained in his paper, and therefore, I hardly feel prepared to say anything on the subject. I felt that the matter of testing underground wires has been in the very best possible hands, and so I have not given as much attention to it as I might otherwise have done. My duties have been confined to the examination of overhead wires and perhaps their condemnation, and I do not know that I can add anything to the subject of wires underground. If there are any questions that anybody would like to ask me about overhead wires, I should be very glad to make an effort to answer them.

A VISITOR: I would like to ask one question—has there been anything in the plans of the New York subway system looking toward the distribution of district circuits? I refer, of course, to the messenger telegraph.

Mr. MAVER: I presume they would be distributed in the same manner as the telephone and telegraph circuits. It is open to the district companies to avail themselves of these methods. That is, they would branch off from the manhole with their cables to the buildings where they have their district boxes.

The VISITOR: The reason I ask the gentleman is, because, generally the district companies put in their boxes free of charge to the subscriber; and the consequence is that the general cost of anything of that kind would be a serious question. What I was getting at was whether the regulations of the subway system would allow such a thing, or whether they would have to put a special main in for each house?

Mr. MAVER: I think I have stated in my remarks concerning the telephone and telegraph that the plan adopted was to run the cable in the subways to the manhole adjacent to the building or block of buildings where it is desired to make connection with the customers. Precisely the same plan, I should think could very readily be followed by the district messenger companies.

In the first part of my paper, to which Mr. Wetzler has alluded, I assumed that a tunnel system would be the most satisfactory if the cost were not beyond all bounds; but it had occurred to me that even if we had such a tunnel on one side or in the middle of a street, there would still remain to be furnished a distributing system. You would either have to pass from the tunnel in the middle or sides of the street or at street corners from manholes, as we do at present. But certainly, in addition to the tunnel, there would necessarily be for proper distribution, especially of electric light currents, a distributing system such as is at present employed above the regular or trunk line ducts. That, of course, would add greatly to the cost of the tunnel.

The CHAIRMAN: I see several gentlemen in the audience who are connected with arc lighting companies in this city. I should imagine that they would have some sentiments to voice on such an occasion as this.

I have noticed that very often when we have a very important paper, one which we think will elicit the most valuable information, it sometimes fails signally of its purpose. For some reason or another we seem half afraid of it. We have before us such a paper this evening; but I would not like to have the meeting close without expressing my own belief that in these subway matters the companies which have been running their lines overhead to the present time have at least something to be said on their side, not so much by way of extenuation or excuse, as by way of explanation. Eight or ten years ago, to go no further back, none of us expected that this electric work in New York City would be done for a long time to come by other than overhead wires. In fact, there was no desire expressed anywhere by anybody for anything but overhead wires. We had then simply the telegraph and allied services. If the overhead wire was not run to furnish some new service, the public grumbled until that wire was run. I think nobody can deny that. Then we had the telephone, and everybody who could afford it wanted telephonic service. The question of having these telephone wires run underground did not enter into the question at all. The only trouble was the price of the telephone service. Then we come down to the period of the electric lighting systems and their introduction into this city, a period of about a decade. Most of you who were present in the city at that time know that there was not the slightest call when the electric wires were first introduced into this city for putting them underground. Everybody said, let us have the electric light. It is a good thing, and the wires were strung overhead. On some thoroughfares, such as the Bowery, for example, they were plastered up so thick that everybody wondered whether the daylight would ever have any show again.

There was very little question as to insulation. The companies, I think, did the best they could. They were pioneers. They were not particularly well instructed in the matter. In fact, I do not think any of us were; and as pioneers, I think those early companies, some of whose work remains with us to this day, are at least entitled to our respect, even if we have to regret their mistakes. Just as long as our pioneers in America remain our glory and our promise for the future, I do not think that we have much occasion to find fault with those who are pioneers of electric lighting in this city, and therefore practically in this country. I recollect some years ago the Marquis of Salisbury ran wires through his garden, and in so doing killed his gardener. I am not aware, however, that the press of England has yet used that incident as the ground of a clamor for deposing him from his position as Prime Minister, or has alluded to it in any way as derogatory to his personal and private character. Had he, however, been connected with an electric lighting company in the city of New York, I dread to think of the things that would have been said about him; of what indictments he would have labored under. As Mr. Maver has told us this evening, the electric lighting companies, when the increase of the wires led to a public call for their being under ground, were offered the choice of any number of systems, and I know that in a great many cases throughout this country a large number of the electric lighting companies put large sums of money in subway work, all of which inside a year had to be written off to profit and loss. It need not be wondered at that companies with such interests at stake desired to go slowly and with fifty or a hundred systems presented to them, each the best and the others all the worst, it is not, I say, to be wondered at, that each company wished some one else would try the experiment first. We all know how the early subway work in connection with the electric lighting in this city failed. As I listened to Mr. Maver's description of that this evening, I was reminded of an incident told me by a fellow journalist a short time ago in connection with the yellow fever epidemic in the South. A young man there who was quite interested in Free Masonry, told his friends that when he died he wished to be buried in regalia. There were very few of his friends left by the progress of the epidemic, and the sad duties were left to an old negro, who was told to go to this man's wardrobe and take his regalia and put it with the deceased in his coffin. It happened that this young man, while a Mason, was also a prominent personage in connection with the Mardi Gras festival, and had distinguished himself at the preceding festival by wearing a peculiarly brilliant and fantastic harlequin costume. You may, perhaps, imagine the consternation of his friends, two or three weeks afterward, when, looking over the young man's effects, they found the Masonic regalia—the harlequin costume was gone. Now, gentlemen, it may seem a false parallel, but the electric wires of this city deserved to be buried in a decent, respectable manner, instead of which they were sent before the great white throne of public opinion in what I may speak of as a harlequin costume. Within the last year, however, there has been an improvement, and I think none of us can gainsay the statement that Mr. Maver has made, which shows that at least the pioneer work of the subways is at the beginning of its end. We have gone through the overhead period for some eight or ten years, and now I think we may perhaps have a pioneer period of eight or ten years in the subway work. But we are getting there. I think all who are interested in the welfare of this business are interested in seeing the wires put underground, if they can be made to work successfully. Mr. Maver has shown us this evening how far the work can be accomplished, and I think it may be safely said that in the subway work of the future all those engaged in it will have the heartiest and best wishes of the American Institute of Electrical Engineers.

If there be no further business I would like to state that I have been asked by the Entertainment Committee of the New York Electric Club to mention that on Thursday evening Mr. Grosvenor P. Lowrey, a well-known lawyer of this city, will read a paper on the subject of patents and their relation to inventors. Any gentlemen who are interested in the subject the Entertainment Committee will be very glad to have as their guests.

I would also like to announce that our subject for the March meeting will in all probability be the Westinghouse tests at Johns Hopkins University. We all know the unimpeachable reputation of that university in such matters. But even if we did not, I think it would be sufficient to say that the paper will be brought before us by our vice-president, Dr. Louis Duncan. That paper will probably be read in March. We have another matter on the programme for March, but it will probably be carried over until very late, or even into April; and that is a lecture at Columbia College by the kind invitation of its officers by Prof. Elihu Thomson on the phenomena of alternating currents, with experiments. I have no doubt that our President will give us a royal evening on that occasion.

Mr. JAMES H. SEYMOUR: I am not a member of this organization. I do not know that I have a right to speak; but I do want to raise my voice in defense of the electric industry against the public howl which is brought forward in the daily press. They think it is incumbent upon them to abuse every man in official position, and every one who is developing the electric industry. I have no remembrance of any industry ever meeting with the obstruction and with the abuse that the electric light business has met with in this city at the hands of the press. The press of New York has not been fair. Why it has not been I am unable to understand. I am aware that the citizens became annoyed with the numerous overhead wires, and wished that they might be buried; and from that howl, and through different commercial organizations they went for the wire question. The press has simply jumped upon the electrical industry and injured it to the amount of many millions of dollars in the United States, and has impeded its progress. I think those who are connected with it as an industry have a right to demand that we shall have fair play and the opportunity to build a subway and to take care of the wires overhead, and if by carelessness on the part of the companies people are killed, they are financially responsible, and let the responsibility rest where it belongs. Because there is an accident from the overhead wires, it is not just to require that the lights must be shut off as has been done in this city during the holiday season, where merchants have lost thousands of dollars in trade. At this point I would like to ask, as Doctor Wheeler invited questions about the overhead wires, why is it that insulation has improved so much in the last few days, from what it was when they were chopping the wires down so recklessly. Perhaps the gentleman can tell us about that. He, I presume, has come in for his share of abuse, and I am ready to defend him when it is required.

Dr. WHEELER: I have been out of town during the last week.

The CHAIRMAN: I think we ought to be extremely glad that Mr. Seymour is with us this evening, and has had the courage to speak on the action of the press in the manner in which he has. He said not a word but what was strictly true. Our industry was treated in the manner that he describes, but the industry will survive, and I have sufficient respect and confidence in the great press of New York City to know that they will be with us. Their own future forbids their being against us.

Dr. WHEELER: As the subject is rather serious, I think I had better make a more careful answer to the last question. As I understaud the question, it is this, Why have the companies found that within the last week their wires are safe enough to light up, while before they were not safe enough? Well, there has not been any difference in the safety of the wires, but from the time that they have been shut down, some months ago, the companies have been unwilling to take the risk of running, because they were ordered to discontinue the use of their wires until the electric adviser of the subway commission would certify that the wires were safe. Of course, I do not think anybody would undertake to go into the insurance business for all the wires in the city, and therefore the wires have not been declared safe. The companies were informed that the wires would all be examined as rapidly as possible, and that it would be necessary to examine them very carefully inch by inch; and that as soon as any wires were found that were safe the companies would be notified. The companies then, after talking the matter over, decided to go ahead and try to make some wires safe, and they came to the Board of Electrical Control and asked that some wires which they thought were pretty good should be examined. These wires were examined, and after going over them for a very small part of the whole distance a number of features about the wires were found which could be improved; that is, improved in an essential respect, and the companies were informed that as the resolution of the board required that the wires should be declared safe, it was not reasonable to expect that those wires would be declared safe as long as they were in a condition that could obviously be improved. The companies then said that they did not think that they could bring them into such a condition—that the changes required were not such that they could bring about, and they stopped work for awhile. Within the last few days they have evidently made up their minds that they would take the responsibility of running their wires; and they have started up one of their stations, and lighted certain lamps. A good many of them are using their cables which they put in the subways, some of the cables being put in since the lines were cut down, but the companies are simply going ahead and taking the risk themselves, which I think they are quite sensible in doing. Before, they were not willing to take this risk, but now they are. The public clamor has subsided to a certain extent and they are simply using their wires.

Mr. SEYMOUR: Are the companies conducting their business without the Board of Electrical Control's permission?

Dr. WHEELER: Do you mean to say permission in respect to the Board declaring that the wires are safe?

Mr. SEYMOUR: No, sir. Permission from the Board of Electrical Control to go on and do the lighting, as the public understand that they were shut down by order of the Board of Electrical Control. I want to know whether they have gone to work without the permission of the Board of Electrical Control or not.

Dr. WHEELER: I do not understand that the Board of Electrical Control has ever refused permission to any company to carry on the electrical business. The board simply passed a resolution at one time requiring the companies to cease the use of such wires as were not properly insulated, and until they could procure a certificate from the expert of the board that the wires were insulated and safe. They have not secured such a certificate, and they have made some effort which would prevent wires from passing an examination, and the matter lay in that condition sometime until within the last few days. Now they have decided that they will take the chance of whether the wires are safe or not—a position which is quite natural for them to take; and I should say quite sensible, because I do not think anybody could undertake to guarantee that all their wires are safe. They are simply operating them themselves, and if their wires are proven to be unsafe, as shown by any accident they will simply be responsible for operating such wires. The board has not declared that any company shall not carry on its business—that is, as I understand it. I do not undertake the legal part of the business; but I do not think that there is any dispute about that.

Mr. SEYMOUR: Then I understand that the companies are going on and ignoring the Board of Electrical Control. If one company has that right they all have that right. If they are taking that position the Board of Electrical Control will practically have to take a back seat. If the companies now are stronger and more important and are simply defying the Board of Electrical Control, why we must know it.

Dr. WHEELER: I do not think the companies have any intention of defying the Board of Electrical Control, and I do not think that the Board has any idea of taking a back seat. The board passed that resolution evidently with the intention of really placing the responsibility where it should be. As there was a question at the time of who was accountable, and to make that perfectly clear, the board passed a resolution that no unsafe wire should be operated. If the companies chose to go on operating wires, and they are unsafe, then the companies are responsible, and if any harm results, they must answer for it.

Mr. SEYMOUR: They had that responsibility before.

Dr. WHEELER: Oh, yes. But there was a good deal of misunderstanding. There was a great many of the newspapers that seemed to think that the board was responsible. And the board tried to make their position perfectly clear by simply passing that resolution.

Mr. SEYMOUR: I think the fact has come out that the authority to destroy the property of electric companies does not exist in the Board of Electrical Control, or any other board; and they have probably taken a different view of that question. There are other ways of stopping business than by destroying property; and the fact that the city would be responsible for the destroying of property probably modified their views in the Board of Electrical Control. I like to get at the facts in these matters, and to defend our business.

Mr. CURTIS: It seems to me that one of the most important questions that has come up to-night has been the question of the comparative cost of tunnels, and what are called subways. Mr. Maver has instituted a comparison between the cost of tunnels for New York and the cost of subways, and the general conclusion from what I have heard to-night seems to me to be that tunnels would cost about $450,000 per mile, and subways would cost something like $3,000 per duct per mile. I cannot see why there should be such a great difference between the cost of subways and the cost of tunnels. Of course, there is this great difference—a tunnel requires a larger excavation, and it requires building the walls of very much heavier material, and it requires special removal and replacing of all the gas mains or electric wires that are there at present, also water mains and steam conduits. But as far as the cost of the tunnel itself is concerned, I do not see why that should be very much greater than the cost of the more expensive or more improved forms of subways. The advantage of tunnels in several respects is certainly very great. Service connections to the house can be made simply by boring through the walls of the tunnel right into the front cellar of the house. The water pipes and the gas pipes and anything that comes along in the nature of a new system—probably something will come along in a few years—can be introduced in the same way. When you consider the saving of cost that can be realized in the next five or ten years in the replacing of the old gas pipes and the old water pipes and the fixing of the sewers, and the constant shifting and adding to and testing of the electric light wires and electric wires of all kinds that would be necessary in order to keep such a system in working order, it seems to me, if it did cost something like $450,000 a mile, at first cost, it is not to be thrown out of consideration at all. If thirty years ago somebody had said, in answer to the proposition to connect New York and Brooklyn by a bridge, that such a bridge would cost fifteen millions of dollars, that would have settled it. But capital was forthcoming. And I do not see why, in the greatest city of this country, capital should not be forthcoming to put the subways or tunnels, or whatever they are, in condition to give the most desirable service possible. It seems to me it is largely a financial question. I do not myself see how any satisfaction can be got by the public or by private interests out of the present way of operating the wires by private corporations. It seems to me a very remarkable state of affairs that a private corporation should be allowed to have a monopoly of building subways for all kinds of electric

* Discussion of a paper read by Mr. Wm. Maver, Jr., before the American Institute of Electrical Engineers, Feb. 18, 1890.

wires, and that a Board of Electrical Control, or anybody for that matter, should have the authority to compel people to put them into those ducts. Because it amounts to an authority, they will not allow them to use them unless they put them underground. There are no other underground conduits so they have got to go there, and it is a very remarkable state of affairs that the company has got to put its wires underground in conduits, but cannot guarantee their working or take care of them properly. It appears to me that much the best plan is for the city to put the streets in such a condition that all kinds of service—heat, electricity, whatever it is—can be had to the best advantage, and although it may cost a great many millions, I think Mr. Maver said that in the principal streets to replace the present subways by tunnels would cost in the neighborhood of thirty millions. Well, if it cost thirty millions to give New York a system of water, gas, electric light, steam heat and sewerage, where there will be perfect access to the houses and where it will accommodate all these forms of supply, it would be a very desirable thing, and it would well repay such an investment. It, perhaps, costs several hundred thousand dollars a mile to pave a wide street in the best style, but a fine pavement is very important, and it is also most important that a city should be supplied with its light in the most convenient way. I think we ought to look far ahead in this matter and not consider whether the cost is three thousand dollars or one hundred thousand dollars per mile. Of course, it is impossible to judge what the consequences have been; and they do not furnish us with the means of arriving at any conclusion. But, although it is a very old idea, nobody has advocated with any emphasis at all the best investment of sufficient capital to obtain the best means of supply for all these conveniences.

Adjourned.

Cornell University Items.

The programme of the annual inspection tours is about completed. These trips are mapped out with considerable care, and opportunities are given those taking them of investigating processes of manufacture and construction, otherwise kept closed to the public. Electrical students will this year have the choice of two trips. One leaving Ithaca, March 20, will visit the electric power plant and light station at Scranton, and from there will go direct to New York, with headquarters at the Cosmopolitan Hotel. The programme then includes visits to the Westinghouse Central Station, Edison Company's office, the Western Union Building, the Excelsior Electric Company's Works, the Edison Light Station, the Eickemeyer Works at Yonkers, the Julien Railroad Station in the city, then Edison's Laboratory at Orange, and the United States Company's factory and Weston's Laboratory at Newark. The special Eastern trip has Boston for a headquarters. From there visits will be made to the Massachusetts Institute of Technology, the Boston Electric Light Company's central stations, the Thomson-Houston Electric Light Co.'s Works at Lynn, Harvard University, Brown & Sharp's Works at Providence, the Mather Electric Company's Works at Manchester, Conn., the Waterbury and Ansonia Works at Hartford, and then on to New York.

Prof. Alex. Graham Bell was the non-resident lecturer Friday last. He treated his subject, "Radiaphony," historically, leading up to the present state of knowledge regarding this wonderful science, and recounting his own exceedingly interesting experiments in this field. After the lecture he presented the University with a radiaphone.

The material equipment of the University has of late been increased by several additions. Four small Edison dynamos—five incandescent light machines—have been purchased. They are intended for experimental purposes only. A Thomson deciameter balance has also been purchased, to be used in the testing of incandescent lamps. A "Poggendorf switch," of Professor Moler's design, has been recently set up in the laboratory, and Mr. Fowler is now at work on a dozen galvanometers, which are also to be constructed in our own shops.

The Electrical Engineering Association has again proved successful this year, both the attendance and the papers presented having been uniformly good. Professor Ryan again evinced his interest in the association at the last meeting by delivering a highly interesting lecture on the "History of the Atlantic Cable."

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, March 8, 1890.

Paul T. Kenny will push the trade throughout the East for the United Edison Manufacturing Company, 65 Fifth Avenue, New York, making a specialty of the Edison incandescent lamps.

The New York Stencil Works, 100 Nassau St., are manufacturers of special steel and rubber type for all purposes, especially indicators, stock registers, etc., and invite interested parties to send for circulars of office specialties.

Robert Blackwell, the former president of the Bentley-Knight Motor & Railway Company, has opened offices at 31 Nassau street, where I know he will be pleased to cater to the wishes of the fraternity on law matters.

The Universal Arc Lamp Company, 15 Courtlandt street, are preparing for a big business in arc lamps for incandescent circuits. Messrs. Noll & Davis, 49 West Twenty-second street, have taken the agency for this section.

Samuel Kyle, the old Dey street telegraph and electrical construction man, has been located for some time at 150 Barrow street, and is very busy on steamship work, and reports that the demand for small motors will be large very shortly on special work.

E. A. Williams & Son, Jersey City, assayers and smelters, are manufacturing a special line of fusible wire; they make strong claims for this wire as to carrying capacity and standard resistance. They also give attention to lead, copper and other castings.

Electrical Attachments for releasing horses and lighting lamps, like those mentioned in these notes last issue as being installed at Newport, R. I., by Hatzel & Buehler, have been put in the New York Hospital Ambulance Stables, this city, by the same firm.

Fenn & Braemar are moving to their fine new offices, 47 Courtlandt street, where they will make a fine exhibition of household and general electric specialties. They are doing a general construction and wiring business. Mr. Fenn is well-known among the trade.

Mr. P. C. Ackerman, American Electrical Works, 18 Cortlandt street, is in a happy mood over the recent receipt of large orders for insulated wire such as one for 50 tons of overhead wire, of the fine, triple-braided, waterproof and weather-proof type. This order naturally takes time to fill, but the customer gladly waits. Mr. Ackerman also reports their special compound annunciator wire to be in great demand, as well as their well-known flexible cord, etc.

Mr. Chalmers has just returned from an extended trip in the interests of the Empire City Electric Company, 15 Dey street. I understand he has brought home some handsome orders which this company can handle to advantage. Their Vienna soft cored carbons are having a good sale, and ought to be used extensively by arc light companies, as they are very economical, and give a fine illumination. They are constantly adding specialties to their already extensive stock of telegraph, telephone, electric light, electric railway, power and fire alarm supplies.

P. A. Dowd & Co., of 239 Broadway, representing in New York the Sprague electric railway and motor interests, have done a most successful business in their territory all over New York, New Jersey and Long Island. Among their latest installations is the new road now being installed at Long Island City and running to Newtown, on the overhead single trolley principle. They are also putting in a ventilation outpit in the German Life Insurance Building, two motors for running elevators at Hartley & Graham's, Maiden Lane, and have put a motor in Folkhart's jewelry manufactory at 4 John street, and have 300 other motors running to refer to in this city.

Hazazer & Stanley are extremely busy on wiring for the electric light and general home and office specialties; their electric bells, annunciators, door openers, etc., are popular goods in the trade and need no word painting to describe them. They are employing a large staff of men on contract work; I believe 75 men was their high-water mark the past week. They count many prominent men in New York, Brooklyn and other sections amongst their customers. At their factory, 32 Frankfort street, they are constantly adding to their already large force, and to facilitate business have moved their offices to 35 Frankfort street, under the management of Mr. Harry Hall, a member of the firm and well known among the trade.

Mr. C. H. Davis, expert and electrical engineer, 120 Broadway, draws up plans and specifications for electric light and power plants, supervises their construction, and gives expert opinions on all kinds of electrical work. Among a few of his installations is a 450 16-c. p. Western Electric Company's incandescent plant put in the ribbon mill of A. and S. Blumenthals, 210 West Eighty-ninth street, N. Y.; 50 lights at H. D. Klots, 507 West Fiftieth street, Thomson-Houston system; 750 lights, Edison system, for Smith & Kaufman; 700 lights in the Century Club; 800 lights, Deutscher Verein; 1,500 lights, Keystone Watch Case Company, Philadelphia; 350, Castle Braid Company, Brooklyn, L. I.; and has a large number of plans and specifications and contracts under way. Mr. Davis has done all the expert work for Thomas H. Park, of Philadelphia, and also on a 3,000-light plant for the Hotel Metropole, Philadelphia.

The Empire City Electric Company have just completed changes in their storerooms at 15 Dey street, which add very much to the attractiveness of the rooms and give the company additional facilities for handling their growing business. The manager's and cashier's offices are now separated from the sales department by a hardwood partition, surmounted by an artistic brass lattice, and electric lights have been put in both for illuminating and to display the large stock of fixtures, cut-outs, shades, etc., which the company carries. These, with other less important changes, make a marked improvement in the appearance of the offices and salesrooms. At the annual stockholders' meeting, held on the 6th, the following named officers were elected, viz.: O. E. Madden, president; E. T. Gilliland and H. L. Storke, vice-presidents; Frederick Lines, secretary; W. T. Black, Jr., treasurer; H. G. Madden, assistant general manager; J. A. Seely and J. C. Tomlinson.

Noll & Davis is the title of a firm of electrical contractors recently organized in this city, for the introduction and installation of all kinds of electric light and power plants. They will give particular attention to the equipment of buildings with the popular interior conduit system, which they believe to be eminently the right thing for this work. Both gentlemen have had years of experience in the various departments of electrical engineering. Mr. C. A. Noll was for some years a member of the firm of Noll Brothers, 65 Fifth avenue, who did so large an amount of wiring and installing for the Edison United Company, of that address. Mr. E. F. Davis was formerly a member of the firm of Hitchcock, Glover & Davis, of this city, and has all the necessary qualifications as an electrical engineer. The firm has the agency for the Universal Arc Lamp Company, whose lamp is intended to run on any low-tension incandescent system of electric lighting. They will also carry a full line of dynamos, motors, fixtures, appliances, and railway supplies, at their headquarters, 49 West 22d street.

Mr. J. H. Shay, the well-known representative of the Charles Munson Belting Company, has been East on a tour of inspection including both Boston and New York. Mr. Shay reports having assisted at a very interesting new departure lately, in connection with electric railway work. The Broadway & Newburgh road at Cleveland has just bought from him 200 feet of 18-inch Munson "dynamo" belting for their new power house, this making 800 feet altogether. The plant involves a radical departure from previous methods. It comprises at present two large Reynolds-Corliss engines built by E. P. Allis & Co., 18 × 42, with 16-foot fly wheels, belting direct from the engine to the dynamos, which are each of 80,000 watt capacity. This method is giving the best satisfaction, and has shown itself equal to severe emergencies. Mr. Samuel Andrews, of the Broadway road, was the pioneer in this project, which, Mr. Shay says, has brought out some excellent features of convenience and economy. The belts in question are 94 and 111 feet. Mr. Andrews is putting in another of these large engines, and it will be installed within the next 60 days.

J. H. Bunnell & Co., 74 Cortlandt street, one of the oldest manufacturers and dealers in telegraph, telephone, electric light, power, fire alarm, district telegraph and messenger supplies, have to-day the finest salesrooms, I think, in this section, equipped with every thing imaginable and necessary for the needs of the various lines of business mentioned above. To meet urgent and immediate demands on large orders and to quote competitive prices, a large and varied stock of electrical goods has always to be carried. For this purpose they have taken the four-story building, 60 Cortlandt street, convenient to their salesrooms, and are filling it up from floor to ceiling in convenient shape, with goods ranging from the ordinary push button to great reels of wire, dynamos, motors, batteries, etc., etc. They also make their porous cup, open circuit and dry batteries here. The first floor will be used in part for packing and shipping goods. Their Eickmeyer dynamos and motors are having a big sale.

The Gibson Electric Company, 74 Cortlandt street, on a recent call, showed me one of their new medical storage batteries, inclosed in a handsome mahogany wood case and fitted inside with black plush, which gives a fine finish to the case and protects the battery from damage. The size of the battery is 4 × 4 × 6½, and contains current sufficient for performing surgical operations. Two will run a dental motor or light a small incandescent lamp for several hours. The case is 9 × 5 × 5. Mr. John A. Cabot, late superintendent of construction for this company, has gone to New Orleans to superintend the construction of storage batteries for the Electric Traction and Manufacturing Company, of New Orleans, licensees of the Gibson Company. This company has contracts for 100 cars now under construction. The Gibson Company have one hundred 13 F. cells on the new car fitted out by the Daft Electric Light Company, of 115 Broadway, which is running in Toledo, O. The Toledo *Daily Commercial* says: "it worked to perfection." The Toledo *Blade* and also the Toledo *Bee* speak in the same terms of the operation of the car. The Gibson Company have cars running successfully at Newark, N. J.; Philadelphia, Pa.; Flushing, L. I. It is remarked on the street that the Gibson Company are about to be absorbed by the Edison Company.

The Tucker Electrical Construction Company installed the electric light plant and also the bell service complete and the static lighting service for the dining and ball-rooms of the handsome new Progress Club at Sixty-third street and Fifth avenue, this city, which was opened on Saturday night last. The electric light plant comprises 1,260 16 c. p. lamps, the current for which is generated by two 650-light Mather compound automatic dynamos driven by two 75 h. p. Armington & Sims engines. The dynamos are automatic in their action, and any number of lights can be turned on or off, the pressure remaining practically constant. The main switchboard of slate is located in the engine-room, and on it are all the switches controlling the lighting of the building. Each dynamo is supplied with an ammeter. One potential indicator is employed, provided with a switch, so that it can be used with either dynamo. The lights in the ball-room on the top floor are connected to a special circuit running from the main switchboard in the engine room. In the ball room is also a beautiful white marble switchboard provided with 21 switches, which control the lighting of the entire room in sections. The switches for static lighting, and the static machines, are also placed upon this board, and directly underneath it are the lever handles for controlling the rheostats for raising or lowering the lights on the stage. The whole board is encased in a handsome cabinet. The best Grimshaw white-core wire was used in this installation throughout the building, and the whole plant is one in which the very best material and workmanship are employed, and reflects great credit upon the Tucker Electrical Construction Company.

The Elektron Manufacturing Company.—A visit to the new shops of the Elektron Manufacturing Company in Brooklyn reveals an establishment which is a model of neatness and convenience. The fire which destroyed the old shops on Nov. 1, last, hastened a removal to more commodious quarters which had been contemplated to accommodate the increasing business of the company. The offices and shops are now located on the third and fourth floors of Nos. 79 and 81 Washington street, only one minute's walk from the East River Bridge entrance, which brings them into easy communication with the business centers of both New York and Brooklyn.

The offices are on the third floor near the entrance. Here may be found Mr. Cutler, the manager, and Mr. Perret, the electrician of the company, together with a competent corps of assistants. Adjoining the offices are the stock room and a completely fitted out testing room for testing the Perret dynamos and motors which they manufacture. The current for testing is generated by two Perret slow-speed dynamos of the multipolar type. The remainder of this floor is occupied by the machine and assembling departments. Since moving into the present quarters the company have added largely to their stock of machinery, and but for the very compact arrangement they would even now be crowded for room in this department. A small room on the north side of the building is used for brass finishing, and is ventilated by a Perrett electric fan, and nearby the very complete equipment of special tools, jigs and standards which are used in the manufacture of the different parts of the dynamos and motors are methodically arranged on shelving. Every part made must fit to a nicety the standard gauges and pass the critical eye of an inspector before being turned over to the stock room or to the assembling department.

One striking feature about the factory is the entire absence of the large iron castings, such as are usually employed in dynamo and motor construction. In place of these, on the south side of the machine room, a large quantity of annealed charcoal sheet iron may be seen, and a number of wheel presses are kept actively engaged in punching this material into plates, from which the laminated field magnets are built up.

The winding department is located on the floor above the machine shop, and is unique in some respects. Owing to the peculiar shape of the field magnets all the winding is done by machines, which are at present operated by hand, but the company contemplate putting in special machinery of their own design in the near future to do this by power.

The Elektron people report quite a demand for their new slow-speed motors and dynamos. Amongst recent local sales of their slow-speed machines I note a 50-light plant for Brooklyn, a 75-light plant for E. E. Garvin & Co., New York, and a 10 h. p. motor to go on the Edison circuit in Brooklyn. The demand for their smaller machines is unprecedented.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, March 8, 1890.

Messrs. Kendall & Slade, the well-known contractors, of 43 Milk street, have been appointed selling agents in this city for the New York Insulated Wire Company, of New York.

The Thomson Electric Welding Company has mailed to its shareholders the report of the United States Naval Board upon the applicability of the electric welding process to naval uses. This report, which we print fuller elsewhere, is very exhaustive in its details, and is one of the highest endorsements which the Welding Company possesses of the multitudinous application and thorough success of their process.

The Suburban Electric Light and Power Company.—Judge Fields, of the Supreme Court, has sustained the demurrer of the defendant in the case of the Suburban Electric Light and Power Company vs. the Board of Aldermen of Boston, which was the petition for a writ of mandamus to compel the aldermen to grant the petitioner a location for its posts in certain districts of the city, which, it was contended, the company was to light under a contract with Superintendent of Lamps Allen. But Judge Field says: "I think that the subject matter of the petition is within the judicial discretion of the Board of Aldermen, and that this discretion cannot be controlled by this court." The petitioner will probably take the case to the full court on appeal.

Boston Electric Club.—At a regular monthly meeting of the Boston Electric Club the following members were duly admitted by ballot: As active members—Messrs. L. H. Rogers, Theodore Gould, Jr.; D. S. McDonald, B. W. Rowell, E. L. Norris, J. T. Davidson, Morris F. Whiton, and Mr. Frank G. Stone, of New York, as an associate member. It was voted that 1,000 copies of Mr. Lord's paper on Electrical Legislation be printed and circulated by the Club. Mr. S. E. Barton asked for the use of the rooms of the club on the occasion of the organization of the Electrical Mutual Insurance Company, and was unanimously granted the privilege. The next monthly dinner was announced to be held at Young's Hotel, on Monday evening, the 10th inst., at which Prof. Elihu Thomson and Mr. Marsden J. Perry are expected to be present, and to take part in a discussion on the "Transmission of Electrical Energy."

Petition for Municipal Plants.—The committee on manufactures yesterday gave a hearing on the petition of Charles E. Bowers and others, and Michael Doyle and others for legislation authorizing cities and towns to manufacture gas and electricity. C. P. Greenough appeared for the Boston Gaslight Company. E. W. Burdett for the Massachusetts Electrical Lighting Association and ex-Senator John C. Crosby for the North Adams Gaslight Company. Mr. Bowers submitted a bill, which, if passed, will permit any city or town to maintain lighting plants upon the two-third vote of the City Council in two successive years in cities, ratified by the people, and in towns by the two-thirds vote of the legal

voters at two annual town meetings. The bill further provides for the issue of 20-year 5 per cent. bonds, outside of the limit of indebtedness, the amount of such bonds to be not over 5 per cent. of the town's or city's indebtedness. The city or town is not to be compelled to furnish gas or electricity to any person or corporation, except by the order of the gas commissioners after proper hearing The bill provides that the business shall be given in charge of a manager, and that the net profits shall not exceed 8 per cent.

PHILADELPHIA NOTES.

Branch Office of The Electrical World,
31 City Trust Building. Philadelphia, March 8, 1890.

Wm. H. Weston & Co., consulting electricians and contractors, have established offices and factory at No. 1,402 South Penn Square, this city.

Wm. H. Weston & Company, of this city, consulting electricians and contractors, have established their office and manufactory at No. 1,402 South Penn square.

Mr. O. D. Pierce, No. 1028 Dickinson street, this city, has been appointed the Philadelphia agent of the Perkins Electric Lamp Company of Hartford and Manchester, Conn.

Messrs. W. S. Griffith & Co., the Philadelphia agents of the Mather Electric Company, report business active, and the demand for the Mather system of electric lighting steadily on the increase.

Mr. John H. Palmer, of this city, the inventor of a novel and highly important electrical device known as the "electric car starter," favored this office with a visit early in the week.

The East Reading Electric Railway has placed an order with the Electric Railway Construction Company for five additional car equipments and for an increase of station capacity. It is extending its line 1½ miles.

The Novelty Electric Company of this city is very busy on its special lines, including new dynamo machines and electric motors. The company's manufacturing facilities are large, which insures the prompt filling of orders.

Mr. Thomas Foley, one of the best known mechanical engineers in his section, has established offices at No. 4,029 Fairmount avenue, West Philadelphia. Mr. Foley has had 25 years' practical experience in steam, hydraulic and electric engineering.

Wilkesbarre.—It was recently stated that the Sprague system of electric railway had been in operation in Wilkesbarre for about three weeks. This is a mistake. The Sprague overhead system has been in successful operation in that city for a period of two years.

Lecture on Electricity.—Prof. Wm. D. Marks delivered a lecture at Association Hall, corner Chestnut and Fifteenth streets, this city, on Wednesday evening, Feb. 19. Subject: "Electricity and its practical applications." The lecturer illustrated his subject by brilliant experiments.

J. Elliot Shaw & Co., of this city, report business active at their factory, and as having an unusually heavy run on their electric call bells and double armature heavy stroke bells. Mr. Shaw authorized me to say that "credit is due to our advertisement in The Electrical World for many of our new customers."

David W. Dunn, for several years connected with the Boston department of the Thomson-Houston Electric Company, has been appointed to an important position on this company's Pennsylvania force. Everybody who knows "Davy" wishes him a prosperous future in his new field of labor.

The Cleverly Electrical Works, this city, are pushing the sale of the popular "Perret" electric motors. Manager Cleverly informs me that since he took in hand the Philadelphia agency of the Perret motor, he has been successful in bringing this meritorious machine into vigorous competition with others.

Col. F. T. Walton, wife and daughter were among the party who joined the "electric special" train as it passed through this city on last Sunday en route for Kansas City. Col. Walton is proprietor of the Hotel Stockton, at Cape May, N. J. He was for many years the popular landlord of the St. James Hotel, New York.

Messrs. Clay & Pepper, electrical contractors, this city, have made estimates during the present week for the installation of nearly 4,000 incandescent lights, together with the wiring and construction work tributary to same, and this firm has orders in hand for constructive work on electric light and power plant equipments aggregating 430 h. p.

Prospective Electric Enterprises.—Advices from Harrisburg, Pa., under date of Feb. 26, reports: "Charters were issued yesterday at the State Department as follows: Scotdale Electric Light, Heat and Power Company, of Westmoreland County, capital, $15,000; the Mill and Mine Electric Equipment Company, of Pittsburgh, capital $10,000."

The Porpoisine Manufacturing Company, 253 Market street, manufacturers of the famous Porpoisine shoe blackings, dressings and harness oil, also prepare a superior lubricating oil for phonographs, typewriters, bicycles and all kinds of finest mechanism. The oil is the finest in the market, will not gum, and is entirely free from acids, etc.

Partrick & Carter, of this city, report a steadily increasing demand for their "Disque Leclanche" batteries since the adoption of the new covered cell with clamp connection, or lead-top connection. One of the firm stated to me recently that "testimonials are being received daily referring in complimentary terms to the improved form of Disque Leclanche battery."

Partrick & Carter, of this city, have just issued a neat little pamphlet containing a description of their Disque Leclanché Battery with improved covered cell. The pamphlet also contains numerous testimonials from the electric-supply dealers, electrical engineers and superintendents of police and fire-alarm systems, setting forth the good qualities of the battery alluded to.

Mr. H. B. Cutter, electrical engineer, No. 1,018 Chestnut street, this city, was recently appointed Pennsylvania agent for the Standard Electric Light Company of St. Johnsbury, Vt. Mr. Cutter installed an incandescent plant—Standard system—in the new Warner building, corner Broad and Wallace streets, this city. The building is wired for 300 incandescent lights of 16 c. p. each.

The Equitable Electric Railway Construction Company have closed a contract with the Federal Street and Pleasant Valley Street Railroad Company, Pittsburgh, Pa., for ten additional 30-h. p. "Sprague" equipment for the company's new road. These equipments are for the Pullman vestibule cars which run on this line, and which are considered the handsomest railway cars in any city in the Union.

An Electric Light Mortgage.—The Conshohocken Electric Light and Power Company has decided to issue first mortgage six per cent. bonds to the amount of $20,000, for the purpose of wiping out the concern's floating debt and extending the plant. The Norristown Title, Trust and Safe Deposit Company has been selected to act as trustee in the mortgage for the bondholders, and to register the bonds.

The Midgely Wire Belt Company, of Beaver Falls, Pa., has established a branch office in Philadelphia, No. 49 North Seventh street, with Mr. James W. Rabe as agent of the company's Eastern department. It is claimed that the Midgely steel wire belt has great strength and flexibility, runs straight and steady under varying loads and high rate of speed, and is peculiarly adapted for electric light and power machines.

The Edison Electric Light Company of Philadelphia has prepared and issued to its new and intending customers an excellent set of specifications for house wiring, with the object of preventing poor wiring and avoiding the troubles that arise from bad work. Prof. W. D. Marks, the supervising engineer and general manager, is to be heartily congratulated upon the systematic reduction he has thus made to practice of the best theory and the total experience in the art.

The Equitable Electric Railway Construction Company, of this city, reports having closed a contract with the Neversink Mountain Electric Railway of Reading, Pa., for the entire electrical equipment of the new mountain railroad. The road when finished will be eight miles long. The electric cars will probably be running before the first of May. Four eight-wheel cars—each equipped with two 15 h. p. Sprague motors—will constitute the initial rolling-stock equipment of the road.

Franklin Institute Lecture.—Capt. Eugene Griffin, of the Thomson-Houston Electric Company, Boston, delivered a lecture at the above-named institution on Monday evening, Feb. 10, subject, "Electric Railways." Capt. Griffin was greeted by a large and intelligent audience, all of whom listened attentively to his remarks, which were replete with solid facts and reliable statistics regarding the advantages and progress of electric propulsion for street cars.

Mr. H. T. Paiste, of this city, manufacturer of the popular "Paiste" cut-outs and switches is actively preparing for the market several new specialties, and prominent among them is his new porcelain pendant "cut-out." Mr. Paiste informs me that he has already in hand several large orders for his new cut-out, all of which must be delivered on or before March 1; and he has an order in hand for a five ampère single pole switch and 10, 20 and 30 ampère double pole switches, to be finished and delivered prior to April 1.

Telephone Cases Submitted.—A special telegram from Harrisburg, Pa., to the Philadelphia *Times* under date of Feb. 10, says: "Four cases against the American Bell Telephone Company, which is charged with owing the State taxes on capital stock and gross receipts, were submitted to the Dauphin Co. Court to-day without argument. The company's defence is that it does no business in this State and that telephoning in Pennsylvania is done by companies which pay a tax to the State. A recent decision, it is claimed, sustains this view."

A "Patent Adjustable Loose Pulley Arrangement" is being manufactured by the Philadelphia Shafting Works. Its economy, where high-speed machinery is in use, is especially apparent, and it is being rapidly adopted by electric light plants throughout the country. It is, to a great extent, a substitute for friction clutch pulleys By its use, it is claimed, there is a direct saving of power, belting, oil and wear on loose pulleys and shafts; Particulars about the "patent adjustable loose pulley arrangement' may be had by addressing Mr. Geo. V. Cresson, corner Eighteenth street and Allegheny avenue, Philadelphia.

Harry G. Clay, Jr., manager Philadelphia office of the Thomson-Houston Motor Company, has made the following electric power installations during the past ten days: At the Sibley Building on Filbert street, this city, a 10 h. p. motor, operating a Morse & Williams passenger elevator, one of the most compact and complete plants of the kind I have seen. At Binder & Kelly's printing establishment on Minor street, also in this city, a 7½ h. p. motor, furnishing power for three of the largest size Campbell cylinder presses, four job presses and two paper cutters. This was one of the quickest installations of the kind on record. Order was received to put in the motor, belting and shafting on Tuesday afternoon, Feb. 11, at three o'clock; the equipment was in position, the wires strung and connections made, and the entire plant in satisfactory working order at noon the following Thursday.

Regulating Interstate Telegraphy.—Advices from Washington, D. C., under date of Feb. 5, say: The bill reported to the Senate to-day to regulate Interstate commerce carried on by telegraph, provides that it shall be unlawful to make unreasonable charges for the service, to give any unreasonable preference or advantage to any person or firm; to enter into any pool for the division of receipts; to give any rebate or reduction in price to any person, firm or corporation, not given to others. Government, State, city and press messages are excepted from the provision relating to special rates, but no discrimination is allowed between newspapers. The bill includes a provision similar to the long and short haul clause in the Interstate Commerce law, making it unlawful for a telegraph company to "charge any more for a shorter than for a longer distance over the same line."

Schleicher, Schumm & Co., proprietors of the "Otto" Gas Engine Works, report satisfactory business and see several important orders ahead for their larger sizes of gas engines. In electric stations owned by gas companies, gas power is establishing for itself a reputation for exceptional economy. Its advantages are based on the facts that a gas works can confine all its handling of coal to the retort house and reduce this expense to a minimum when it uses gas power and has no separate boiler house with an extra set of men; besides, the pound of coal goes as far, if not further, in a gas engine than in a steam engine, for producing a horse power, and the receipts from coke and tar give a drawback on the coal bills, which can not be had on coal reduced to ash under boilers. Other electrical companies, not identified with gas interests, are investigating the merits of gas power in connection with producer gas, as practical tests have long ago shown that in this manner a coal consumption of 1½ pounds per horse power can be reached. Besides direct economy in fuel, there is the feature with gas power of being able to limit the expense directly to the time power is used or required. Among the plants recently equipped with "Otto" gas engines is that of Rockville, Conn., 80 h. p.; Donaldsonville, Conn., 50 h. p., and shipments are under way, each of a 50 h. p. "Otto" gas engine, to the electric companies in Barnesville (Ohio), and Portsmouth (Ohio), and Morris (Ill).

Thackara Manufacturing Company.—As briefly alluded to in my notes recently, this well-known concern has moved into its magnificent new building, 1,524 and 1,526 Chestnut street, which has attracted so much attention during the process of erection, and which is, without doubt, the handsomest establishment of its kind in the country. The Thackara company has long held a prominent position among the manufacturers of gas and electric fixtures and art metal work in this country, and the increased facilities afforded by having the manufacturing departments and the salesroom under one roof, as in the new quarters, will advance it even further, in this respect. The new building is seven stories high on the Chestnut street front, which is of French sandstone and pressed brick, treated with pleasing architectural effect. The front is 42 feet 6 inches, the building extending through to Sansom street a distance of 235 feet, where it is six stories high. The process of manufacturing begins upon the fifth floor, where are the molding and casting shops, and the work is continued in regular stages through the descending floors until the basement is reached where the finished fixtures and chandeliers are ready for the market. The principal retail show and salesrooms are on the first floor, with heavy French plate-glass windows looking out into Chestnut street, and are models of beauty and convenient arrangement. In the front portion are massed every variety and style of gas and electric fixtures, embracing ormolu, bronze, onyx, glass and innumerable other kinds. Extending back upon the right are a series of luxuriously furnished smaller rooms, given up to the display of the finest fixtures and metal work. The apartments are lighted by electricity and furnished with soft Oriental rugs, rich furniture and divided by graceful portieres. The wholesale departments are upon the upper floors, and are connected by a system of speaking tubes with the remainder of the building. In the rear of the first floor is a miniature telephone exchange and telephones are scattered throught the immense establishment, allowing communication between all parts. A rapid Otis elevator, steam heat and electric lighting are other conveniences. The members of this enterprising firm are Benjamin Thackara, the president, who has held that position since 1864; Charles Thackara, ice-president; A. M. Thackara, superintendent, and Wilbur F. Duffy, secretary and treasurer. The history of the firm extends back to 1842.

W. I. B.

Chambersburg, Pa., Feb. 24, 1890.

The Electric Light Plant.—By an almost unanimous vote of the people at the regular election last fall, the Chambersburg, Pa., town council were authorized to advertise for bids for the installation of an electric light plant. In the latter part of November, the Thomson-Houston Electric Light Company, of Philadelphia, were awarded the contract for the electrical plant, and the Taylor Manufacturing Company that for the steam plant, and work was at once begun. Under the personal supervision of their energetic electrical expert, Mr. Daniel Killian, the Thomson-Houston people pushed their work rapidly to completion. Mr. Frank Lowry, mechanical expert for the Taylor Company, superintended the steam plant construction. Mr. Daniel Gilbert is the superintendent and engineer of the station, which is 41 feet wide and 55 feet long. The building is of handsome design and very complete and attractive in its interior arrangement. The engine room contains two 35-light arc Thomson-Houston dynamos of the most approved pattern, and embodying the most successful and economical principles of arc dynamo construction. The engine is an 80-h. p. Beck automatic high speed engine with 11½ × 15-inch cylinder, and with the dynamos rests on deep and solid foundations facilitating swift and noiseless operation. The boiler is 66 inches in diameter by 16 feet long and of 100 h. p., and is placed in a separate room. The station is also most advantageously located, being central and within a few yards of the main line of the Cumberland Valley Railroad, from which a siding projects, expediting the unloading of coal, etc., at the boiler house door. The satisfaction that the Beck engine gives in electrical dynamo service is demonstrated by the exceeding steadiness and constancy of its operation, in driving the dynamos. The superiority of the Thomson-Houston light as an illuminant is voiced in the general expression of satisfaction and delight that is heard on all sides, alike from citizens and strangers competent of judging. The initial start was made on the evening of Feb. 13, when Miss Bessie Beck, daughter of Superintendent R. M. Beck, of the Taylor Mfg. Company, turned the throttle of the engine, and the current flashed along the 14 miles of circuit. The entire town and surrounding country turned out in honor of the occasion, and a parade of the police, fire, and musical organizations, headed by the members of Town Council, took place. Every electric light station in the Cumberland Valley, namely, at Carlisle and Cambersburg, Pa., Hagerstown and Cumberland, Md., and Winchester, Va., has Beck engines driving its dynamos.

WESTERN NOTES.

Branch Office of The Electrical World,
39 Mallers Building, Chicago, March 8, 1890.

Wilmette, Ill., is agitating the question of electric lights.

Col. D. B. Dyer, of Kansas City, is endeavoring to have an electric railway installed in Augusta, Ga.

Mr. E. D. Floyd, the purchasing agent of the Thomson-Houston Electric Company, has gone to Boston on a business trip.

Mr. Geo. M. Hurd, of Monroe, Mich., was in the city last week looking up the good points of the various electric light systems.

The Sperry Electric Company, Chicago, report the receipt on Friday last of an order for the complete apparatus for 170 Sperry arc lights.

Mr. S. D. Nesmith, of Toledo, has been figuring with some Chicago parties for the necessary material for an electric plant of considerable size.

The Pueblo, Col., Gas and Electric Light Company have ordered three more dynamos to enable them to supply the demand for "more light."

Mr. A. G. Glascow, Superintendent of the Kansas City Gas and Coke Company, has gone East to investigate the merits of electricity for illuminating purposes.

The Consolidated Electric Light Company, Kansas City, Kans., have secured a franchise and will light the village of Rosedale for a period of ten years.

The Edison Electric Light Company, Cincinnati, have retained the services of Ex-Governor Foraker to press their rights for an underground service in that city.

The East St. Louis, Ill., Electric Street Railroad has been incorporated, to operate a railroad; capital stock, $150,000; incorporators, D. Sullivan, H. F. Bader, and H. D. Sexton.

The Brush Electric Company of Cleveland have brought suit against the Union Railway Company of Indianapolis, Ind., for using a double carbon lamp that infringes on the Brush patent.

The Western Electric Company, Chicago, has brought suit in the U. S. Circuit Court, against Mr. T. B. Smith, for infringement of patent No. 172,993 covering improvements in electric annunciators.

The Noiseless Audiphone Company was recently organized in Kansas City to handle the patents covering J. J. Wolf's earphone The capital stock is divided between A. M. Sloss, Max Well and J. J. Wolf.

M. B. Willard, of the Thomson-Houston Electric Company, is installing an electric railway system on the line of the North Illinois street and Fairview Park Railway Company, in Indianapolis, Ind.

The Evansville, Ind., Gas and Electric Light Company, was sold to a syndicate which is believed to represent the Standard Oil Trust. The price paid was $700,000, or $100,000 more than the capital.

The Evansville, Ind., Electric Light and Power Company has been duly incorporated with a capital stock of $100,000, by Thos. B. Byrne, William McLean, Cicero Buchanan, Allen Gray, A. M. Owens.

Mr. O. M. Hubbard, Cincinnati agent for the Jenney Electric Motor Co., of Indianapolis, recently installed a Jenney motor for service in pumping the mammoth organ at the Odeon and Cincinnati College of Music.

The Chicago, Milwaukee & Lake Superior Telegraph Company's new line between Escanaba and Marquette is in full operation and giving excellent satisfaction. This is the line built by George Cutter, of Chicago.

Dr. Paul Schoop, of Zurich, Switzerland, is in the city arranging for the handling of his accumulator, which is now manufactured at the Oerlikon Works in Zurich, and which was referred to in THE ELECTRICAL WORLD of July 20, 1889.

Interesting to Inventors.—Judge Blodgett, Chicago, has decided that if an inventor puts his invention into use and sells it and then obtains a patent covering same, he cannot enjoin the use of the machines previously sold or constructed by him.

Heisler Electric Light Company:—Manager Walter F. Smith reports the business of his company not only very satisfactory but steadily increasing in volume, owing to the demand for the Heisler system of electric lighting in all sections of the country.

The Chicago Long-Distance Telephone Company has been incorporated to do such business as is necessary to the construction and maintenance of a telephone line; capital stock, $1,000,000; incorporators, W. R. Omohundro, L. M. Hopkins, and W. M. Rheem.

The Marquette Electric Construction Company has been organized and incorporated in Chicago to operate electric machinery for the purpose of furnishing light, heat, and power; capital stock, $25,000; incorporators, Alfred L. Baker, Samuel S. Parks, and Eben F. Runyan, Jr.

Mr. W. J. Ferris, of Louisville, writes: "I have just started a 5 h. p. Thomson-Houston motor here for pumping purposes, in Seelbach's Hotel, to raise the water to the roof for elevator work. It is a great saving in running expense compared with the water from the street mains. The outfit is very compact."

The Electrical Supply Company, Chicago, have received a large number of the celebrated Ayrton & Perry's direct reading volt-meters and am-meters, the readings on which range from a fractional part of a unit to one hundred or more. Altogether it is the largest consignment of these goods ever received in the West.

The Western Union Telegraph Company has leased the old auction house on the south side of Pine street, between Broadway and Fourth street, St. Louis, for a term of ten years, from Mr. R. J. Lucas, at an annual rental of $6,700. The building is four stories high, and occupies a lot 40 × 105 feet. About $12,000 will be expended in improvements.

The Electrical Supply Company, Chicago, are in receipt almost daily of orders for their Ellis oil filter, which they usually send out on 30 days' trial. And the fact that not one filter has ever been returned, but, on the contrary, the purchasers refer to the actual economy effected in the saving of oil, speaks highly for the efficiency of the filter.

The Novelty Electrical Supply Company, Cincinnati, having found their business far outgrowing their old location, are moving to more convenient quarters at 83 Coleman street. Their various specialities, some of which were described in THE ELECTRICAL WORLD of Feb. 1, are classed as staple articles by the trade in general, owing to their ready sale.

The Rapid Transit Electric Railway, of Colorado Springs, Col., are installing 16 miles of the Sprague system. Mr. F. E. Downs, of Denver, has charge of the installation, while Owen Ford will superintend the wiring. The officers of the company are P. W. Martin, president, and A. L. Lawton, secretary: A. A. McGoverny, treasurer; E. J. Eaton, director.

Mr. Geo. T. Manson, of Okonite fame, and Mr. W. H. McKinlock, of the Central Electric Company, Western agents of the same company, who have been traveling extensively through the South on business, have both got back from the trip, well pleased with the results, and have, as usual, succeeded in having a good time right through and making lots of friends.

Mr. John J. Enright, of New York, gave a public exhibition of the Gamewell auxiliary fire alarm system in the council chamber at Detroit last week. It is the desire of many of the Aldermen that the system be installed, as the boxes are supplied and kept in repair at an annual rental of only ten dollars. Mr. H. P. Simmons, of New York, has also been with Mr. Enright.

The Carpenter Electric and Storage Company, Denver Col., have equipped a chair car attached to the fast express with a system of electric lighting. On a recent run from Denver to Chicago Dr. W. A. Johnston and his brother, Mr. T. G. Johnston, of Denver, were passengers on the car, and explained the merits of the system to a number of railway officials.

Street Car Charter.—The Chicago corporation owning the street car lines in Indianapolis has secured a charter for thirty-five years on no condition except that the company shall connect the suburb of West Indianapolis with the city. Either animal or electric power may be used. The company will at once put down several miles of track. The franchise is worth from $3,000 to $5,000 a year.

George Cutter, Chicago, was fortunate in disposing of his entire exhibit at Kansas City before leaving there, thus saving the expense and trouble of shipping it home. Mr. Cutter has secured a patent on his combination tin shade for incandescent lamps, which has proved to be a very saleable article, and business generally has increased so rapidly that additional store room has been secured.

The Novelty Electric Supply Company, of 83 Coleman street, Cincinnati, O., have been successful in introducing their combination pole top on the lines of the Cincinnati Street Railway Company, whose road of 34 miles will be exclusively equipped with them. The Novelty Company are receiving large orders for their arc lamp windlass and insulated pulleys, and report business generally brisk.

The J. C. Walsh Gasoline Torch Manufacturing Company, Chicago, who suffered so severely by reason of the several fires occurring in the old Burton block, are again in operation at 48 West Adams street, and about ready to fill large orders for their blow-pipe torches and continuous gasoline blast torch for linemen's use, both of which were illustrated in THE ELECTRICAL WORLD of Aug. 3, 1889.

Mr. M. B. Bailey, the Engineer in Chief of the Government building, in referring to the electric light plant there operated, said: "During the past year we ran every day of the 365—that is we never stopped our machines from January 1st till December 31st., running day and night, except for 29½ minutes on one occasion, when a bolt in a clutch slipped out and had to be replaced." The system used is the United States (Weston).

The Knapp Electrical Works, Chicago, have secured the exclusive agency for the middle west, of Young's automatic safety cut-out, described in the THE ELECTRICAL WORLD of Feb. 1, 1890, and which has been especially designed for use on all-high tension circuits, to insure safety against accidents. It operates automatically, to render the wires "dead" instantly on the breaking of the circuit, and so quick and efficient is its action, that an accident following the breaking of a high tension circuit wire, is said to be an impossibility.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$290@$295	Cumberland	$ 59@ $60
Central Union	58@ 59	Wisconsin	116@ 117
Michigan	96@ 98	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	23@ 25
Colorado	38@ 40	Missouri and Kansas	54@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$91@$93	Chicago Edison Co	$108@$112

Mr. W. E. Phelps, a prominent coal miner of Elmwood, Ill., was in the city last week, and in referring to his electrical plant, said: "The value of electricity in its application to certain work required in mines cannot be overestimated. In our own experience the practical saving in operating expenses in the driving of the pump alone is remarkable. Formerly it cost us—say the relative sum of $1,200 to operate our pumps by steam, while the cost now is less than $300. When using steam the prime factor of expense was the cost of maintenance and operation, and each extension of the line of pipes meant an additional consumption of power. With the electric motor you can move your pump to any part of the mine, and at an expense of less than $50 a discharge pipe can be driven or sunk through the earth to the proper level, and the circuit completed with wires drawn through a smaller pipe, and this can be repeated as often as necessary."

Incorporations.—The Warrensburg Electric Company, of Warrensburg, Johnson County, Mo.; capital, $25,000. Incorporators, James H. Christopher, of Pertle Springs, Mo.; James D. Eads, of Warrensburg, Mo., and George B. Shaw, of Eau Claire, Wis. Object, to manufacture, generate and sell electricity for light, heat and motive power. The Commercial Telegraph Company, of St. Louis; capital, $60,000. Incorporators, H. F. Kleibacker, St. Louis, and G. M. Meyers, E. L. Martin, C. E. Hopkins, P. H. Madden, S. B. Ladd, all of Kansas City. Object, to construct and operate lines of magnetic telegraph. The Cobb Electric Lamp Company, of Chicago; capital, $100,000. To manufacture electric lamps. Incorporators, C. E. Gaylord, C. N. White, and M. J. Trust. The Mount Pulaski Electric Company at Decatur, Ill., to furnish, light, heat and power, with a capital stock of $6,000; incorporators, G. J. Parke, V. H. Parke and W. B. Chambers. The Cook County Passenger Railway Company, at Chicago, to operate a street railway; capital stock $100,000; incorporators, N. Atchison, G. S. Dudley, H. J. Reynolds. Illinois Electric Material Company, at Chicago; to deal in electric goods; capital stock, $25,000; incorporators, A. J. Stone, E. F. Abbott and C. E. Byrne.

The Detroit Electrical Manufacturing Company is the name of a new organization that has completed and filed its articles of association. The company is capitalized at $350,000, with $35,000 of cash already paid in. Those associating are Thomas Harris, Henry F. DeB. Cameron, Wm. C. Bennett, N. K. Riddle, Alfred Woodward and Wm. L. Wild. The first two are the well-known English electrical inventors, and the new company will own all the patents Mr. Harris has taken out, among them the plate used in his improved storage battery, which he confidently asserts has an advantage of 14 per cent. over any other device. The motor employing the plate has been under test on one of the Detroit electric railways for the past two months, and it is upon the demonstration made that the new company is organized. The company will also own the "Harris improved Wimshurst Influence Machine," and will do a general business in the line of manufacturing electrical goods of all kinds, particularly for the equipment of storage battery electric railways. A site will be selected at once and the erection of works begin without delay. The shares of stock subscribed is as follows: Bennett, 5,000; Riddle, 5,000; Wild, $5,000; Harris, 3,334; Woodward, 3,333; Cameron, 3,333. The directors yesterday elected Wm. O. Bennett, president; Nelson K. Riddle, vice-president, and Wm. L. Wild, secretary and treasurer. Mr. Harris will be the general superintendent.

St. Louis Notes.—The Citizens' Electric Light and Power Company, of East St. Louis, gave a banquet in their new station on the completion of their power house, after which the guests were conveyed about the city in carriages to witness the perfect illumination afforded. The Fort Wayne Electric Company furnished the electrical apparatus, the dynamos being driven by Westinghouse engines.

The Lindell Railway Company, having had twelve Sprague motor cars in operation for some time, are now having their entire line equipped with Sprague apparatus, the complete installation calling for 1,000 h. p. in generators and in steam power, and 100 motor cars, each equipped with two 15 h. p. Sprague motors.

Mr. Frank J. Sprague, of New York, visited St. Louis last week.

Mr. Jas. J. Wood, of the Fort Wayne Electric Company, explained to the Board of Public Works the advantages that he thought would be derived from using his improved arc lamp.

Bailey Roeth, proprietor of the Union Telegraph Company, which promises to make a skilled telegraph operator of a student in three months upon payment of $40, was arrested March 6 for fraud. Roeth is said to have obtained about $10,000 in the past six months from gullible students at $40 a head. He stipulated that all graduates would receive situations worth $100 a month. When graduates demanded situations, Roeth would smile and say he had a nice place in South America, Mexico or Siberia, which a man or woman about the size of the graduate could fill. F. DE L.

BRYAN, O., March 3, 1890.

The Electric Light Plant installed here Sept. 1, 1889, is in successful operation with four circuits, with 21 miles of "K K" line wire. The station is a neat, substantial brick structure, 35 × 54 feet, 150 h. p. boiler, one 85 h. p. Beck engine, which is certainly one of the quietest and smoothest running engines I have ever seen. The fuel used is Lima crude oil, which is stored in three buried tanks, and which is raised and fed to the burner by an independent engine. In the dynamo room are three dynamos, two 35-light Schuyler machines and one 50-light Schuyler machine, giving one hundred and twenty 2,000 c. p. arc lights, which for brilliancy cannot be surpassed, if they can be equaled. There are 42 double carbon street lights, and the remainder of the 78 are used in stores. The four circuits are two street circuits, one 10 o'clock and one 12 o'clock circuit. The commercial lighting began June 1, 1889, and the corporation started Sept. 1, 1889, at which time the company secured their contract with the town. The inside wiring is done with underwriter wire. The power is less than ¾ h. p. to each 2,000-c. p. lamp at 9 6-10 amperes. There have been several committees here viewing the lights, and they are all full of praise for the Schuyler system. The successful working of this plant has sold other plants to the village of Hicksville, the town of Hudson, Mich., and also to the town of Angola, Ind. K.

THE TELEGRAPH.

The Direct U. S. Cable Company has opened a new branch office at 40 Hope street, Glasgow, Scotland, very conveniently situated for the produce merchants of that city.

The Fast-Sending Telegraphic Tournament.—Mr. A. B Chandler, president of the Postal Telegraph & Cable Company, has written Mr. Catlin expressing his deep interest in the forthcoming fast-sending telegraphic tournament and enclosing his company's check for $50 as a subscription. Mr. Chandler points out that desirable as is high speed yet still more important is accuracy, and he offers a prize of $10 to the operator who in the tournament shall be adjudged the clearest and best sender, regardless of speed, and another prize also of $10 to the receiving operator who shall make the best "pen and ink copy," including all the "ear marks" required for the identification and record of messages.

Referring to Mr. Chandler's prizes, Mr. Catlin says: "I appreciate the importance of receiving operators making a clear and accurate copy under observation and criticism, and shall feel disappointed if some of our operator 'artists' do not compete for this prize."

The regular prizes offered are as follows: Class A, first prize, $100; second prize, $75. Class B, first prize, $85; second prize, $65. Ladies class, first prize, $50; second prize, $40. Old timers, first prize, $50; second prize, $40.

THE ELECTRIC LIGHT.

The Mount Morris Electric Light and Power Company, of New York City, is about to increase the capacity of its central station plant in Harlem. The company ordered a few days ago Westinghouse alternating current apparatus of 1,500 lights capacity. With this addition, the total capacity of the plant will be 11,500 lights.

The Beaver Valley Electric Company, of Rochester, Pa., is about to begin the furnishing of electric light. The organization was chartered a short time ago, and a few days since a contract was made with the Westinghouse Electric Company, of Pittsburgh, for alternating current apparatus. The company will start out with a capacity of 1,000 lights, and increase as occasion demands.

The Key West Gas & Electric Lighting Company has just been purchased by the Thomson-Houston Company, which thus secures all the plant of the former, and a 30-years exclusive franchise for furnishing the city of Key West with gas and electric lights. This is one of the most valuable rights that has recently been acquired in the South. The Thomson-Houston Company are to be in operation by Nov. 1.

Denison, Tex.—Since the Westinghouse Electric Company has brought out its new arc light system, orders for arc lighting apparatus have wonderfully increased. Among the latest contracts is one for a 60-light arc machine for Denison, Tex., and another from Saratoga, N. Y., for the same kind of dynamo. The plant in Saratoga Springs is a new one, and it will be furnished exclusively with Westinghouse apparatus, the incandescent light capacity amounting to 1,500 lamps.

Pasadena, Cal.—Mr. S. L. Walkley writes us: "We have an electric light company here, and a city council. Recently, on account of the cost of wood out here, the electric light company has been using iron poles, where but two or three wires were carried, on account of their cheapness. The local papers have been declaiming against them, urging the great danger in their use, and the matter has finally come up before our city fathers, who have wisely referred it to the city health officer. What his decision will be I cannot predict."

Dowagiac, Mich.—The people of Dowagiac, a little town in Michigan, must be exceedingly well pleased with their incandescent street lighting system. The local newspaper, the Dowagiac *Times*, devotes over two columns of its space in a late issue to a full description of the electric light plant and extols the merits and advantages of the system in an unstinted manner, capping the climax by stating that Dowagiac is the best lighted city in the United States. The plant has a capacity of 750 lights, generated by a Westinghouse alternating current dynamo.

Laconia, N. H.—The Laconia Electric Lighting Company has partly reorganized. Mr. J. F. Merrill has been elected general manager, vice A. H Rennie, of New York, resigned, and Gardner Cook, director, vice N. Irving, of New York, resigned, making it altogether a local company. It has 50 arcs of the Arnoux-Hochhausen system in operation and 1,200 incandescent lamps of the Edison 3-wire system. The arcs are run by steam and the incandescents by water power, but the company proposes to put in a 190 h. p. Cummer automatic engine, using sawmill waste for the boilers, and to discard the water power altogether. R. G. Reilly is the superintendent.

Dr. V. T. McGillycuddy, the superintendent and electrician of the Rapid City, Dak., Electric and Gas Light Company, is visiting friends in the East while settling up some business matters, and will probably place an order for an alternating dynamo and apparatus before his return. Although he has now settled down as a quiet member of the electrical fraternity, there are few men living who have had the same adventurous experience in frontier life that Dr. McGillycuddy has enjoyed from the time his failing health compelled him to give up the position of demonstrator of anatomy in the Medical College at Detroit till he resigned the government office of Indian Agent of the well-known Red Cloud tribe of Sioux. In 1873 he was connected with the International surveys along the 49th parallel; in 1874 with Custer in his famous march to the Black Hills; in 1876-77 with Crook and the gallant Mackenzie, until after the death of Crazy Horse, when he led the long line of Sioux that filed across the Chadron on their way to the Missouri on that cold, blustery day in the fall of 1877. Since then his record as the guardian of the interests of that most rebellious set of Indians is well known, and for once the copper-colored men found a master who knew no fear.

APPLICATIONS OF POWER.

Mr. George Westinghouse, Jr., has devised a new type of brake for use on electric street car lines.

A Telegram from London, dated March 6, states: The promoters of the scheme to substitute electricity for steam as the motive power on the underground railway system of London are enthusiastic over the successful test of one of their motors, which was made on the Clapham line yesterday. The motor drew an ordinary train at the rate of 20 miles an hour without the slightest

difficulty, and the fact that the work was performed 70 feet beneath the surface and involved passage through the tunnels under the river showed the fallacy of the objections of those who have contended that the use of electricity underground is not practicable.

MISCELLANEOUS NOTES.

Mr. Edison Ready for Work Again.—Mr. Edison has been spending a month in Charlotte, N. C., with his family. He had a severe attack of influenza, but letters that have been received in Orange from him recently say he has fully recovered and is ready for work again. He expects to be back in Orange in about ten days. He has been vaccinated during his trip in the South.

Important Decision.—In Chaffee v. Telephone Construction Company, Supreme Court of Michigan, November, 1889, it was held that one who erects a building by the side of telegraph and telephone wires, which are on his own land, makes no protest against the maintaining of the wires, allows his tenant in the building to use one of the wires for business purposes, and thus goes on for years, making no complaint whatever, cannot recover of the owner of the wires for losses on the building by fire which might have been averted but for the hindrance to the work of the firemen, occasioned by the wires. This judgment was rendered by a divided bench. Campbell, J., dissenting, said that while delay in complaining might cut off a right to sue in equity, "nothing short of a statutory limitation can bar a suit at law; and where a wrongful entry or intrusion is made without license, no license can be legally presumed from inaction. It is not in the power of a city to license anyone to damage or encroach on the property of individuals, and no justification can be based on it."—*The Law*, March, 1890.

Westinghouse Electric Company, Pittsburgh, Pa.—The method of furnishing electric light on the meter system is daily becoming more and more recognized as the only equitable manner of supplying the electric current. This is a fact which is now as readily acknowledged by the consumer as by the electric light companies. The former appreciates the meter because he knows he only pays for what he uses; and the companies are equally confident, because the meter assures them a fair return for their invested capital.

In view of this it is not to be wondered at that the sale of meters for registering the electric current is constantly increasing. Among the alternating current meters the Shallenberger meter, owned and manufactured by the Westinghouse Electric Company, Pittsburgh, Pa., has met with extraordinary success. The company has already made over 17,000 meters, of which number 16,000 are in actual daily operation, while the balance are contracted for.

The meter is a purely mechanical contrivance, and its workings are perfectly accurate.

BUSINESS NOTICES.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas lighting batteries if accidentally grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company of Syracuse, N. Y., No. 105 South Warren street.

Okonite.—The Pittsburgh *Leader* of Feb. 23, publishes an article entitled "The Deadly Wire," in which a vigorous protest against poor and careless workmanship and the employment of cheap material in the wiring of public and private buildings is made. It protests and rightly so against the employment of any but first class and competent men to carry out the work. With reference to a safe and reliable wire, the *Leader* prints a lengthy interview with Mr. George O. Morse, of the Morse Supply and Construction Company, of Pittsburgh, agents of the Okonite Company in that city, who proves himself to be a thorough believer in the insulating properties of Okonite, and recommends its use very strongly.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS ISSUED FEBRUARY 18, 1890.

421,394. Railway Telegraph; James S. Foley, of Toronto, Ontario, Canada, Assignor of one-half to Joseph Ruse, of same place. Application filed May 31, 1889. In an electric signaling apparatus, wires connected to an electric magnetic bell, buffers normally electrically connected to the wires to form an electrical connection between the cars in combination with binding-posts and a circuit making mechanism.

421,39[illegible]. Cut-Out; Gustav A. Frei, of Boston, Mass., Assignor to the Bernstein Electric Light Company, of Portland, Me. Application filed Oct. 12, 1888. The invention consists of an electro magnet, in the magnetic field of which the main line contacts are placed. A pivoted lever or arm is held in its abnormal position against the tension of a spring by a fusible retaining link, the

No. 421,781.—ELECTRIC CONDUCTOR.

link being adjacent to the main line contacts, so as to be heated by the arc established.

421,398. Conduit for Electric Railways; Patrick H. Griffen, of Buffalo, N. Y. Application filed Nov. 9, 1889. A conduit for electrical conductors, composed of a metallic body with a non-conducting lining attached thereto by means of prongs.

421,439. Annunciator; Thomas H. Shipway and James R. Dowdell, of Toronto, Ontario, Canada. Application filed Oct. 9, 1889. The invention consists of an arm pivoted on the face of the annunciator frame in such a manner that the arm will drop at right angles to the centre of the magnet the instant that the circuit is completed through the same.

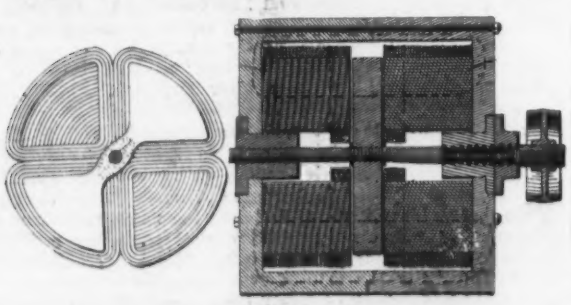
421,449. Electro-Magnetic Valve-Controller; John V. Stout, of Easton, Penn. Application filed Nov. 15, 1889. In an apparatus for actuating valves, dampers and the like, the combination of a main lever, a locking device arranged to move into and out of the path of the main lever, to lock or release the same, armatures carried by the levers, and electro magnets arranged within attracting distances of the armatures and serving to move the levers.

421,457. Electric Belt; Merian Wadleigh, of Kansas City, Mo., Assignor to Clarence S. Gilbert, of same place. Application filed June 25, 1889. In an electric belt, the combination, with a battery, of an induction coil connected to the terminal wires of the battery, the electrodes connected, respectively, to one of the terminal wires and to the induction coil, the vibrator, the switch connected to the terminal wires, and connecting wires connecting the switch to the vibrator and one of the electrodes.

421,464. Electric Railway Car; Herbert C. Wirt, of Boston, Mass. Application filed Jan. 19, 1889. The invention consists in including in series with the motor a storage battery and connecting the lamps in multiple arc with the storage battery, the lamps being in a series with the motor.

421,469. Arc-Light Carbon; Walter Ernest Adeney and Llewellyn Saunderson, of Kingstown, County of Dublin, Ireland. Application filed May 15, 1889. The invention consists in the manufacture of carbons from a mixture of coke, coal, and an infusable or a difficultly fusible material by heating the mixture under pressure in a mold.

421,479. Dynamo Electric Machine; DeWill B. Brace, of Lincoln, Neb. Application filed August 27, 1889. The combina-



No. 421,479.—DYNAMO ELECTRIC MACHINE.

tion, with fixed field magnets having two or more opposing pairs of fixed polar projections, wound with armature coils of magnetizable masses moving in a plane perpendicular to the magnetic force between the opposing poles, and successively closing the magnetic circuit between successive pairs of polas.

421,498. Apparatus for Heating Water and Generating Steam by Electricity; John C. Hubinger, of Keokuk, Iowa. Application filed July 13, 1889. The invention consists in bringing sections or columns of the water within the influence of the electric current between and around a pair of plates, creating currents in the mass of the water, so that the whole mass comes subject to the required conditions, whereby the entire mass is rapidly heated and steam generated.

421,499. Art of Heating Water and Generating Steam by Electricity; John C. Hubinger, of Keokuk, Iowa. Application filed July 13, 1889. The invention consists in transmitting through a limited and comparatively small section or column of the water to be heated an electrical current of sufficient energy to overcome the resistance of such section or column, thereby directly heating the same, causing consequent circulation in the water, and the entire mass or body to become progressively in like manner part of the circuit and heated, and steam to be generated therefrom.

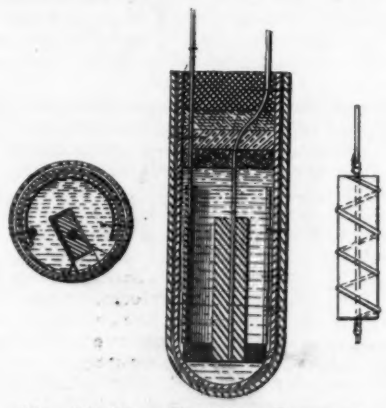
421,508. Electrical Annunciator; Albert F. Parks, of Troy, Assignor to Charles E. Lee, of Rochester, N. Y. Application filed Aug. 27, 1887. The combination of an indicating plate or other surface, one or more rods for same to slide upon, teeth on the indication plate or surface, an electro-magnet with armature arranged to engage the teeth or their equivalent, metallic section strips and one or more combs to move over the strips.

421,530. Time-Alarm; George H. Straight, of Kingston R. I. Application filed Aug. 13, 1889. The invention consists of a relay or station having an electrically-connected, loosely-mounted wheel revolving in unison with the hour hand of an electric time-piece or central clock, conducting and non-conducting discs secured to a central shaft, springs connecting the wheel and discs, a dial and pointer, means for revolving the shaft, an alarm circuit electrically connected with the discs, and a switch for short circuiting the current passing through the alarm circuit.

421,535. Switch for Systems of Electric Locomotion; Frank Wheeler, of Meriden, Conn. Application filed June 19, 1889. The invention consists in a rising and falling or vertically movable and laterally adjustable switch track.

421,567. Electric Clock; William Grah, Jr., of Toledo, O. Application filed May 19, 1888. In combination with a sliding bolt, a nose piece pivoted thereto, a dog or catch for locking the nose piece in position, and means for operating or releasing the dog or catch.

421,596. Incandescent Lamp Socket; William P. Kookogey, of Brooklyn, Assignor to the Kookogey Electric Company, of New York, N. Y. Application filed Sept. 26, 1889. The invention consists, in general, of a socket for incandescent lamps containing a branch circuit through which the integrity of that part of the circuit containing the lamp is maintained when the lamp is cut-



No. 421,801.—ELECTRIC BATTERY.

out, and a circuit closer in such socket, independent of the lamps, to open and close the lamp-circuit in alternation with each other.

421,630. Electric Lamp Adapter; James Stewart, of New York, N. Y. Assignor of one-half to Edmund C. Stanton, of same place. Application filed August 4, 1888. An electric lamp adapter formed of a button of insulating material, a screw-threaded peripheral band surrounding the button, a ring imbedded in the button and connected electrically with the band, and a central stud, provided with a contact piece.

421,636. Telephone Switch; Erastus C. Titus, of Catskill, N. Y., Assignor of one-half to Harry M. C. Vedder, of same place. Application filed Sept. 3, 1889. The combination of the switch-board, the angle plates of conducting material secured thereto, the elastic switch lever secured firmly between the angle-plates, and the contact plates secured to the switch-board on opposite sides of the switch lever and having upturned contact points.

421,666. Electrode for Secondary Batteries; Hiram H. Carpenter, of New York, N. Y. Application filed Dec. 2, 1889. The invention consists in forming a thin, strong casing or support for the active material by submitting metal in a suitable mode to a heavy pressure, whereby a casing or support of great density and durability is obtained.

421,677. Support for Trolley Wires; John H. Cunningham, of Chelsea, Mass. Application filed Oct. 4, 1889. The invention comprises the application, preferably, to each end of the supporting wire of a take-up spring carried by the pole and of sufficient strength and movement to permit of the contraction or elongation of the wire preferably from the trolley support in in either direction. See illustration.

421,733. Carbon for Arc Lamps; Edward L. Liedke, of Sandusky, O., Assignor of one-half to Frank K. McCormick, of same place. Application filed July 22, 1889. A hollow carbon, having a reduced solid end formed integral therewith, whereby the carbon has nearly the same area in cross section at all points in its length, and is adapted to be held in a small holder of small bore. See illustration.

421,781. Electric Conductor; John A. Stoughton, of East Hartford, Conn. Application filed Dec. 4, 1889. The invention consists of a metallic wire or other conductor of electricity, in combination with a series of mutually articulated glass cylinders inclosing the conductor. See illustration.

421,790. Electric Motor; Phillip B. Walsh, of Philadelphia Assignor to Charles M. Rhodes, of same place. Application filed Oct. 3, 1888. The invention consists in the combination with a brush and a brush holder loosely pivoted to lugs on the holder bar by means of a pintle; the brush is kept normally in contact with the commutator by means of a spool spring arranged on the pintle.

421,791. Electric Railway Signal; Willie C. Walter, of Richmond, Va., Assignor of one-half to George B. McAdams, of same place. Application filed May 29, 1889. An electric railway signal, consisting of a pair of parallel conductors insulated from each other and extending along the track, a pair of moving vehicles on the track, each vehicle having a circuit connected with the two conductors, a source of electricity in the circuit, an electric alarm in the circuit, a multiple switch having its movable and a stationary contact connected with the main circuit, a short circuit connected with another stationary point of the switch and with the main circuit between one of the conductors and the source and alarm, another short circuit connected with another stationary point of the switch and main circuit, and a telegraph key in the last-mentioned short circuit.

421,800. Mouth-Piece for Telephones; Ruel W. Whitney and Byron K. Cowles, of San Francisco, Cal. Application filed Oct. 2, 1889. A tubular holder for telephone mouth-pieces, screw threaded for the purpose of receiving a mouth-piece, and having on its inner end a gauze wire-netting, to prevent the too forcible sound of the voice passing through.

421,801. Electric Battery; Charles Williams, and Gustav A. Liebig, Jr., of Baltimore, Md., Assignors to the John A. Barrett Battery Company, of same place. Application filed Oct. 31, 1889. A seal or stopper for an electric battery, consisting of a mass of adherent material in a viscous or semi-fluid condition in which the battery wires are embedded, a superimposed solid

No. 421,733.—CARBON FOR ARC LAMPS.

stopper, and a hard substance arranged below the adherent material, forming the foundation for the stopper. See illustration.

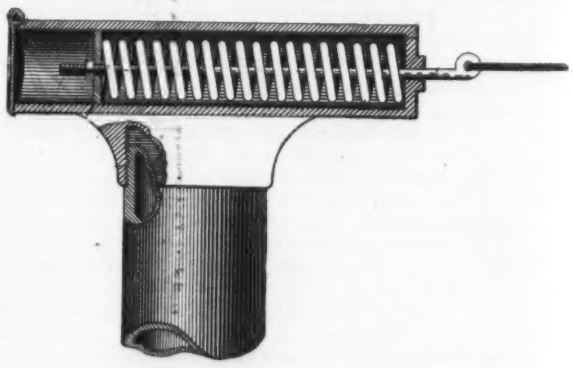
421,802. Flexible Electric Connection; John F. Wollensak, of Chicago, Ill. Application filed Oct. 19, 1889. The combination of a floor plate, a flange extending out therefrom and bent or overlapping at its edge, an insulating piece fastened thereto by the bent or overlapping edge of the flange, and tubes arranged in the insulating piece and in metallic connection with the wires of the circuit.

421,819. Insulator; John W. Davy, of Pittsburgh, Pa. Application filed June 26, 1889. An electric insulator, consisting of two separate members adapted to be clamped together, each having a base or a dovetailed portion on its lower side, and one member having a groove in its side to receive the conductor, and the other member having a corresponding tongue on its inner side to fit in the groove and clamp the conductor therein.

421,851. Electrical Indicator; Leo Bock, Jr., of New York, N. Y., Assignor of one-half to Charles L. Wright, of same place. Application filed July 18, 1889. The invention consists, in providing circuit making and breaking devices operated correspondingly with the movement of the elevator and opening and closing electric circuits, including electro-magnetic devices, actuating a disc, wheel, or plate bearing indicating numbers, letters, or other characters.

421,853. Automatic Fire Alarm System; George F. Bulen, of Tompkinsville, N. Y. Application filed June 18, 1889. In a fire alarm system, the combination of a main line from the central station to the building under protection, a local circuit comprising a given number of normally connected sections and in proximity to the main line within the building, thermostats in connection with the main and local lines, an automatic circuit controlling device, through which the sections of the local line are connected in series, and an electro magnet in a circuit adapted to be completed by the closing of a connection between the main and local lines by one of the thermostats, and adapted, when energized, to set in operation the circuit controlling device, whereby the several sections of the local line are isolated from each other.

421,854. Automatic Fire Alarm Transmitter; George F. Bulen, of Tompkinsville, N. Y. Application filed June 18, 1889. The combination, in a thermostatic fire-alarm transmitter with a spring actuated train and contact arm carried thereby, and forming one terminal of an electric circuit, of an insulated metallic inclosing case forming the other terminal of the circuit, and having a line of perforations therein, and removable metallic



No. 421,677.—SUPPORT FOR TROLLEY WIRES.

plugs or contacts inserted in perforations in position to be encountered by the contact arm.

421,864. Hanging Device for Electric Lamps; William H. Layng, of New York, N. Y., Assignor to S. Samuel Miller, Paul J. Chassagne and William R. Palmer, of Akron, O. Application filed Oct. 25, 1888. The combination, with a spring actuated roller, a supporting frame, and wires connecting an electric lamp with a dynamo, of collars rigidly fastened to the roller to which the wires from the lamp are attached and collars loosely mounted upon the rigid collars and to which are attached the wires from the dynamo.

421,882. Visual Annunciator for Call-Boxes; Paul Seiller, of San Francisco, Cal. Application filed June, 21, 1889. In a call-box the visible annunciator mounted upon one end of a lever, a cam upon the character wheel engaging the opposite end of the levers, whereby the lever is moved about its fulcrum so as to conceal the annunciator, a magnet, an armature actuated by the magnet, and carrying a detent by which the lever is held up until released by the action of the magnet.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give date and number, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.

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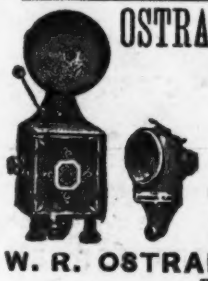

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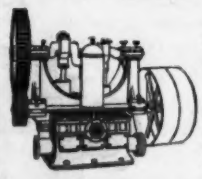

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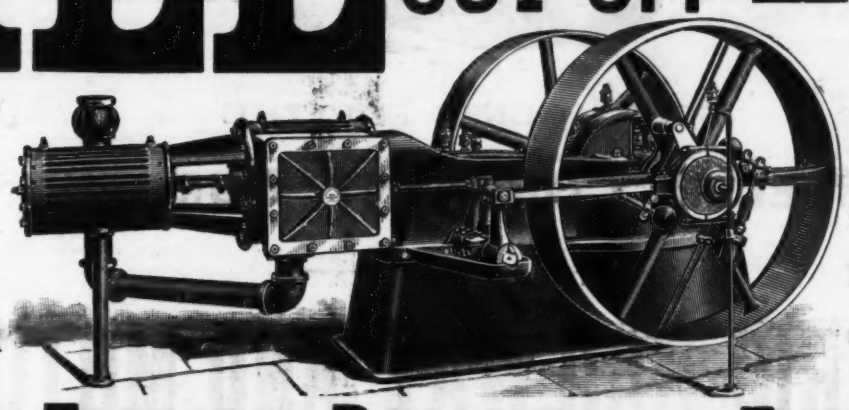

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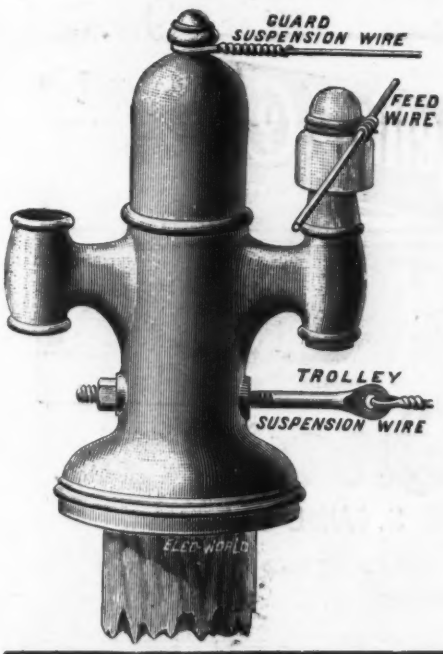

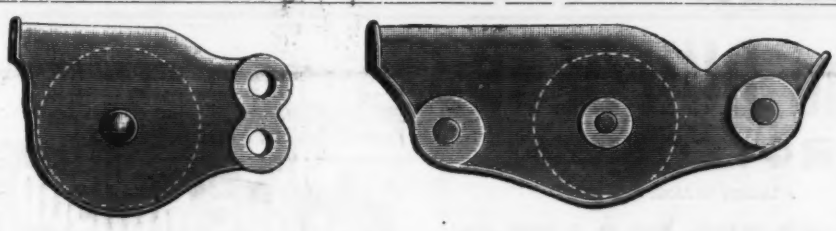

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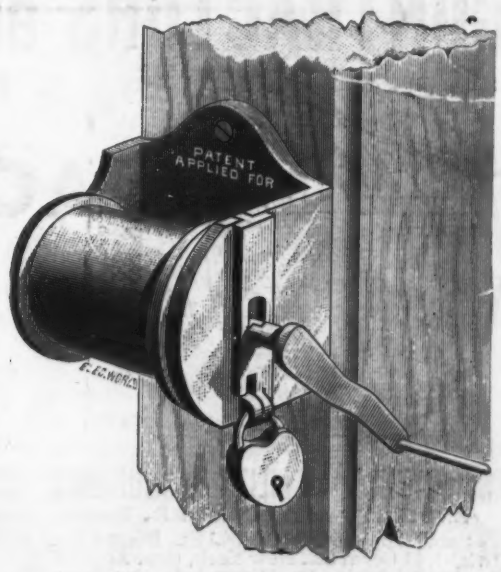

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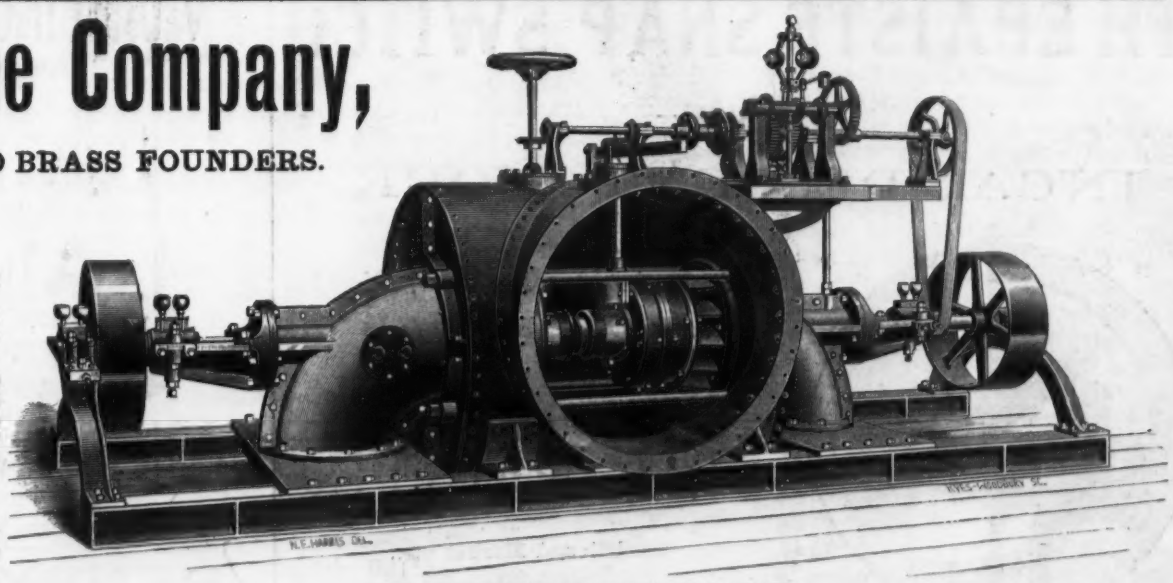

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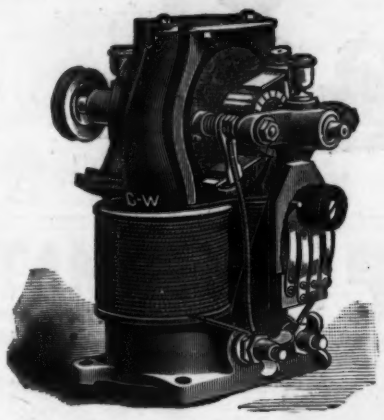

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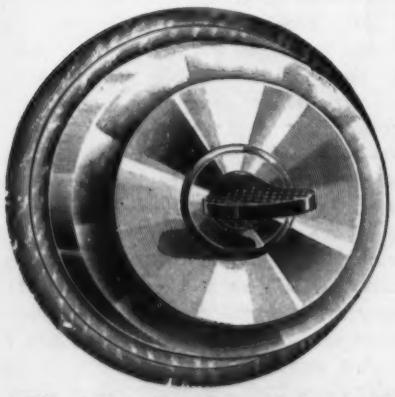

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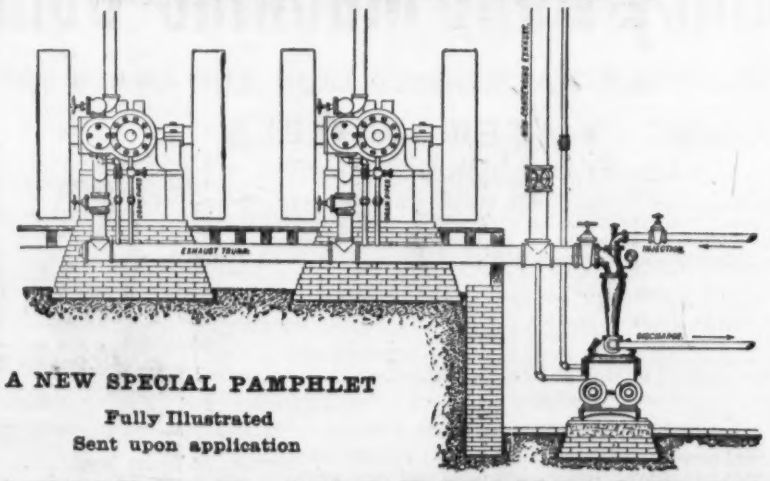

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